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ABSTRACT

This research addressed two major issues: (1) equity as it is reflected in the access of students to educational resources; and (2) efficiency as it is reflected in the use of the resources provided for the education of children. The research, which was begun in 1979, was designed to obtain data on the use of resources and the structure of classrooms in elementary schools which were seeking to individualize instruction for their students. School and classroom resources were defined broadly for the purpose of this research to include both human resources--primarily the time of students, teachers, and other school personnel--and material resources, such as books and instructional aids. The major sections of this document present reports on studies of: (1) time utilization and student performance; (2) school expenditures and student achievement; (3) home environment and student achievement; (4) student achievement and the personal characteristics, instructional behaviors and professional beliefs of their teachers; and (5) school resources, home environment, and gain in student achievement in grades 3-5. Findings and conclusions derived from the analysis of data developed by the studies are presented at the end of each section. Data from which conclusions were drawn are present in tables. An appendix contains abstracts of dissertations by graduate students who assisted in various aspects of this research project.
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Program Report 86-7

RESOURCE UTILIZATION IN SCHOOLS AND CLASSROOMS:
FINAL REPORT

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Professor Lloyd E. Frohreich, who authored Section III of this report, also deserves special mention. He was involved throughout the course of the project and made important contributions to the design, execution and completion of the work. Finally, special thanks are due to Elvira Benter, who typed early drafts of the manuscript, and Carol Jean Roche, who typed the final draft.

R. A. R.

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SECTION I

INTRODUCTION

This research addressed two major issues which pervade both the literature in the field of educational finance and the debate of policymakers: (1) equity as it is reflected in the access of students to educational resources and (2) efficiency as it is reflected in the use of the resources provided for the education of children. The research, which was begun in 1979, was designed to obtain data on the use of resources and the structure of classrooms in elementary schools which were seeking, in some fashion, to individualize instruction for their students. School and classroom resources were defined broadly for the purpose of this research to include both human resources--primarily the time of students, teachers, and other school personnel--and material resources such as books, instructional aids, and the like.

Several questions and issues concerning equity in the provision of resources for the education of children in the public schools were raised by Cubberley (1906) in his original studies of the effects of state educational finance provisions, and many of the same questions and issues persist today. Despairing of success in their efforts to achieve greater equity in the allocation of educational resources through the legislative process, those seeking reform of state school finance programs have pursued their quest in the courts during the past 15 years. The primary thrust of their efforts has been directed at the school district level, and their goal has been to achieve a more even distribution of fiscal resources among a state's school districts. With a few notable exceptions, e.g., Mills vs. Board of Education (1972), little attention has been directed to potential inequities in the allocation and use of resources within districts at the school and classroom level.

Research evidence concerning inequities which may arise as a result of the way in which schools and classrooms are structured and operated is limited. Gerwin (1969) described the budgetary processes employed in a large urban school district, and Mandel (1975) studied the allocation of resources within school districts. Rossmiller, Hale and Frohreich (1970) described the resource configurations most commonly applied in programs for exceptional children, and Kakalik, Furry, Thomas and Carney (1981) studied the level and nature of resources being used in contemporary programs for handicapped children. Research concerning the flow of resources over time to individual students in regular classrooms is, with the exception of Thomas' work (1979), conspicuously absent. The present research was designed to provide detailed information concerning resource flows to individual students in elementary schools and to seek to identify inequities which result from the differential manner in which resources are applied by teachers in instructional programs for individual pupils.

A Schema for Studying Classroom Resource Usage

Figure 1.1 is a schema developed by Rossmiller and Geske (1977) portraying how various resources drawn from the school's environment flow to classrooms and are applied within programs to produce student learning outcomes.

The External Environment

A school system draws its resources from the community in which it is embedded and deploys these resources to individual schools and thence to classrooms within each school. There is considerable research evidence substantiating the view that a community's socioeconomic characteristics, values, attitudes, and expectations bear a significant relationship to the outcomes of schooling. The knowledge, skill, and attitudes which students and teachers bring to a classroom--whether acquired in the home, in the community, or from previous educational experiences--can affect significantly the specific mix of resources and the instructional procedures and processes used in teaching either an individual student or groups of students. The amount of money available to a school system is influenced strongly by the economic resources of the community in which it is located and by that community's willingness to support education. The social and demographic composition of a community constitutes yet another set of variables that affects what occurs in classrooms. The educational level and the occupations of adults interact with economic and other factors to shape attitudes toward and expectations held for the school. And factors such as the rate of population growth or decline and the age structure of the population will affect the level of human and material resources available to a school and hence to classrooms within that school. In short, a school does not exist in a vacuum; it exists in a distinctive environment, and the educational processes and procedures within a school and its classrooms inevitably will be influenced by the nature of the community it serves and the needs of its students (Getzels, Lipham and Campbell 1968: 157-81).

Schools operate within a well-defined policy framework. Aims, priorities, and controls are established by public officials at local, state, and national levels and include constitutional requirements, judicial mandates, statutory directives, and administrative rules that control or constrain the educational process at the classroom level. For example, contracts between a governing board and the teaching staff may impose constraints on class size, hours of work, length of the school year, compensation of employes, and other variables directly related to the educational process. Governmental units may exercise explicit or implicit control through funding mechanisms, or they may establish minimum standards, prescribe curricular requirements, or stipulate certification requirements for educational personnel, thus influencing the nature of the resources available and the processes and procedures employed in school classrooms.

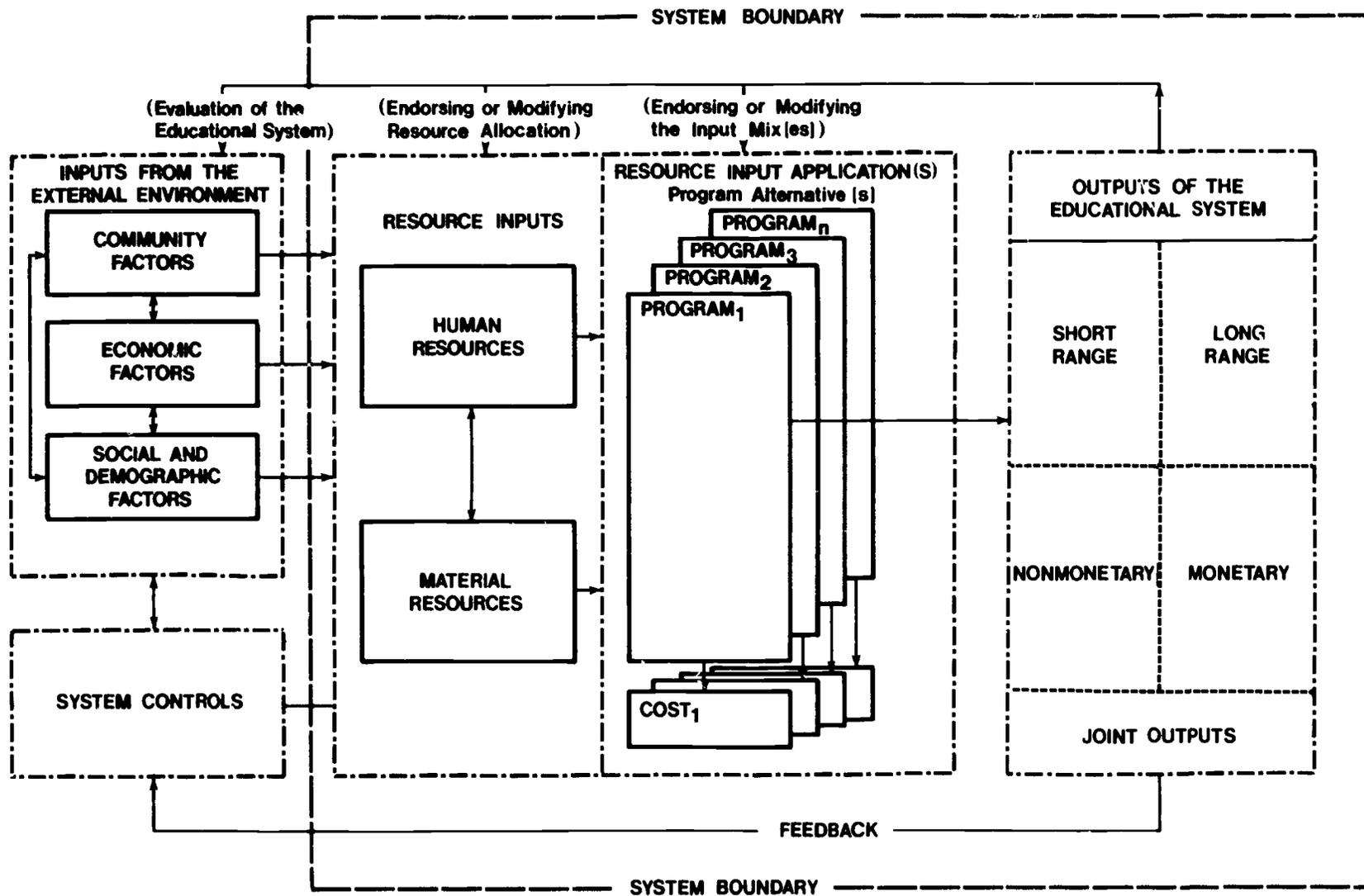


Figure 1.1 A conceptual framework of the educational production process under school conditions
Rossmiller and Geske (1977).

The School as a System

The second major component of the schema shown in Figure 1 consists of the individual school and its classrooms. This component is further subdivided into two elements--resource inputs and resource applications. Resource inputs may, in turn, be grouped into two major categories--human resources and material resources. Human resources include students, teachers, administrators, and other supporting personnel. Material resources include the school building and equipment, instructional media and learning aids, and all of the paraphernalia employed in the instructional process. Students are the most important human resource input for without them there would be no need for the school. Home and community background factors exert strong influence on the aspirations, motivations, skills, and knowledge of students. Because of the differences among students, teachers must be thoroughly familiar with the students in their classes if they are to manage the resources at their disposal efficiently and effectively. For example, very able students are likely to need different educational programs and experiences than marginal students if they are to achieve their full potential.

Personnel employed by the school--teachers, administrators, counselors, psychologists, librarians, and others directly involved in the learning process--constitute another very important human resource. Research indicates that certain teacher characteristics are significantly related to school outcomes and that some teachers may be able to work more effectively with some students than with others (Murnane 1975; Summers and Wolfe 1975).

The largest material resource is the school plant, but computers, audiovisual equipment, desks, books, and an extensive array of other learning aids and equipment are utilized by students and teachers. Research to date has not yet consistently revealed significant relationships between student learning and the material resources used in their education. Some investigators have found variables (age of the school building and percentage of substandard classrooms, for example) that were statistically significant in regression analyses (Thomas 1962); others have found no statistically significant relationships (Murnane 1975).

The Resource Mix: Program Alternatives

One of the most important responsibilities of the teacher is to identify the most efficient and effective ways in which to combine the human and material resources available in the classroom to achieve students' educational goals and objectives. Teachers in large measure control the process through which resources are transformed into learning outcomes. It is their knowledge, skill and intuition that determine the efficiency and effectiveness with which school resources are used. In determining the most appropriate resource mix for an individual student, both the content (reading, mathematics, science, language, etc.) and the instructional process must be considered.

The way the time of students and the teacher is used in the instructional process seems particularly important. Carroll (1963) made

time a central variable in his model of school learning because he assumed that students differ in the amount of time they require to master a given unit of learning. Bloom (1974: 682) noted, "All learning, whether done in school or elsewhere, requires time Time for school learning is even more limited by the resources available for it, by the ways in which these resources are made available to the particular segments of the population, and by the ways in which schools and individuals use the time available to them." Other investigators have pointed out that time is subject to policy manipulation; for example, the length of the school year or the length of the school day can be changed (Wiley and Harnischfeger 1974). Although the length of the school year and the school day define the total time available for instruction, the actual exposure of a student to instruction is determined by other factors such as a student's school attendance, the nature of the instructional program, and decisions made by teachers within the classroom (Rossmiller 1978, Garner 1978). Thus time must be regarded as a significant variable in the resource mix.

Outputs of the School and Classroom

The results (outputs) of the educational activities carried on within a school or classroom can be classified in various ways. For example, they may be categorized as short- or long-range, as cognitive or affective, or as monetary or nonmonetary. These categories are not mutually exclusive, thus creating the potential for a very complex matrix of outputs. However categorized, the results of the instructional activities within a school or classroom must be consistent with the goals and objectives established for individual students and for the school.

Because the long-range and monetary outcomes of schooling can only be assessed over a period of time extending well beyond the student's school years, the results of instruction within a classroom typically are evaluated in terms of such short-range outcomes as measures of cognitive, affective, or psychomotor performance. Students may demonstrate in various ways that they have achieved specific objectives. Some outcomes of schooling can be assessed by using a standardized achievement test or a test of basic knowledge; other outcomes are best assessed by observing a student's performance of certain tasks requiring intellectual and/or motor skills. Still other objectives may best be assessed through anecdotal records and observation of students both within and outside the school.

"Incidental" outputs also merit consideration. Incidental outputs occur whether or not they are desired and, indeed, may be unintended. For example, one incidental outcome of the educational process could be a change in staff or student morale. Although changes in staff or student morale seldom are identified as the primary objective of a school or classroom program, morale may be a factor in the progress of students within a classroom. Thus, incidental outputs cannot be ignored.

Feedback

The final component of the schema is feedback. Feedback occurs continuously, whether or not it is identified as such. Teachers observe students in classrooms and modify their instructional strategies accordingly; they administer check tests or unit examinations to assess student mastery of important concepts; or they use work samples to assess student mastery of skills. These sources of information provide the basis for modifying instructional strategies, using different instructional media or materials, or altering grouping arrangements.

Feedback not only provides a basis for altering the use of resources within an individual school or classroom, it may result in altering the level of resources the community makes available to the schools. Dissatisfaction with the results obtained by a school may, for example, result in a decision to make more (or less) resources available to the school. Feedback may lead to decisions that alter the nature of the instructional process within a given curricular area by instituting changes in the allocation of time to various subjects or changes in staffing patterns. In short, feedback ties the system together and insures that it will remain dynamic and sensitive to changing needs and conditions.

Population and Sample

The data for this longitudinal study were collected from Fall 1979, through Spring 1982, in four Wisconsin elementary schools. The subjects were approximately 240 students who were in grade 3 during the 1979-80 school year; these students were followed during their fourth- and fifth-grade years (1980-81 and 1981-82). The student sample also included children who entered school in Fall 1980, at the beginning of their fourth-grade year. In addition, data were collected from parents, teachers, and other professional staff members who instructed any student in the study and from school and district administrative personnel.

The four schools met the following criteria for participation in the study:

1. They represented varying demographic characteristics.
2. They were expected to maintain relatively stable enrollment patterns.
3. They professed a commitment to individualize education, in some manner, for each student.
4. They were willing to participate for the duration of the study.

Community Characteristics

General demographic information from the 1980 national census for the four communities in which the schools are located is presented in Table 1.1. Data for the state of Wisconsin also are provided for purposes of comparison. Two of the schools were located in urban areas of over 50,000 people; the other two schools were located in communities of less than 10,000 inhabitants. While there is variation among the communities in geographic setting, educational level, and occupational status, as Table 1.2 indicates, the four communities were relatively homogeneous with respect to median family income and poverty levels. The income and poverty levels in these communities also are quite representative of Wisconsin as a whole; however, they tend to have higher educational and occupational levels than the state in general.

School District Characteristics

Data obtained for the school year 1979-80 from the Wisconsin Department of Public Instruction for the four school districts containing these elementary schools and for other Wisconsin school districts of similar size are presented in Table 1.3. These data include average daily membership, pupil/teacher ratio, minority enrollment, average contract salary, teachers' average years of local experience, teachers' average years of total experience, cost per member, cost per member less transportation, and equalized valuation per member.

Seven other Wisconsin school districts served community populations similar in size to District 1. For those seven districts, a mean and standard deviation were calculated for each of the nine variables. The results indicate that District 1, when compared to other districts serving similar population sizes, fell within one standard deviation of the mean in all nine categories.

Districts 2 and 3 were compared to Wisconsin school districts with average daily membership ranging between 1,500 and 3,000 students using the mean and standard deviation for each variable. When compared to these districts, both District 2 and District 3 fell within one standard deviation of the mean on eight of the nine variables. The average daily membership of each district was slightly more than one standard deviation above the mean of the 70 comparable districts.

District 4 was compared to other Wisconsin districts with average daily memberships of 3,000 to 5,000 students. District 4 fell within one standard deviation of the mean on five of the nine variables. The average daily membership of School District 4 was more than two standard deviations above the mean for this group. The district was more than one standard deviation below the mean on average contract salary, teachers' average years of local experience, cost per member, and cost per member less transportation.

The data presented in Table 1.3 suggest that the four school districts in which the elementary schools included in this study were located were not atypical when compared to other Wisconsin school districts of similar size.

Table 1.1

CHARACTERISTICS OF COMMUNITIES IN WHICH SAMPLE SCHOOLS WERE LOCATED¹

| School | Community population | Type of area and geographic location | High school graduates ² (%) | 4+ years college ² (%) | 1979 median family income | 1979 family income below poverty level (%) |
|-----------|----------------------|---|--|-----------------------------------|---------------------------|--|
| 1 | 51,500 | Medium city, light industry, northwestern Wisconsin | 77.3 | 20.4 | \$19,135 | 7.1 |
| 2 | 4,100 | Small town/rural, large industry nearby, southern Wisconsin | 78.0 | 14.6 | 21,181 | 3.2 |
| 3 | 10,000 | Small city, light industry, southern Wisconsin | 66.9 | 14.3 | 20,648 | 3.6 |
| 4 | 53,000 | Medium city/urbanized area, light industry, north central Wisconsin | 68.1 | 14.6 | 20,770 | 4.8 |
| Wisconsin | 4,705,800 | | 69.6 | 14.8 | 20,915 | 6.3 |

¹Data from 1980 Census.²Persons 25 years and older.

Table 1.2

OCCUPATIONAL STATUS BY MAJOR CATEGORIES IN THE COMMUNITIES IN WHICH SAMPLE SCHOOLS WERE LOCATED¹

| School (Community) | Managerial, professional (%) | Technical, sales, administrative support (%) | Service (%) | Farming, forestry, fishing (%) | Precision production, crafts, repair (%) | Operators, fabricators, laborers (%) |
|--------------------|------------------------------|--|-------------|--------------------------------|--|--------------------------------------|
| 1 | 24.6 | 33.6 | 18.6 | .9 | 8.3 | 14.0 |
| 2 | 17.9 | 35.4 | 15.4 | .4 | 10.3 | 20.6 |
| 3 | 22.6 | 29.5 | 13.5 | 1.8 | 13.4 | 19.1 |
| 4 | 21.9 | 33.4 | 14.6 | .7 | 10.1 | 19.2 |
| Wisconsin | 20.1 | 27.4 | 14.1 | 5.5 | 12.1 | 20.9 |

¹Data from 1980 Census for employed persons over 16 years of age.

Table 1.3

COMPARISON OF SAMPLE SCHOOL DISTRICTS WITH OTHER WISCONSIN SCHOOL DISTRICTS SERVING
COMMUNITIES OF SIMILAR SIZE OR HAVING SIMILAR AVERAGE DAILY MEMBERSHIP (ADM)

| Variable | School District 1 | Other school districts serving communities of similar population size (N = 7) | | School District 2 | School District 3 | Other school districts with ADM of 1,500 to 3,000 students (N = 70) | | School District 4 | Other school districts with ADM of 3,000 to 5,000 students (N = 25) | |
|---|-------------------|---|--------|-------------------|-------------------|---|--------|-------------------|---|--------|
| | | Mean | S.D. | | | Mean | S.D. | | Mean | S.D. |
| Total ADM | 9,767 | 9,702 | 2,103 | 2,471 | 2,692 | 2,044 | 381 | 4,621 | 3,699 | 435 |
| Total pupil/teacher ratio | 17:1 | 16.76:1 | 1.55 | 17.1:1 | 15.9:1 | 16.54:1 | 1.79 | 17.3:1 | 16.83:1 | .85 |
| Minority enrollment | 203 | 335 | 271 | 11 | 20 | 56 | 70.53 | 80 | 80 | 52 |
| Contract salary average | 17,756 | 17,020 | 1,208 | 14,591 | 15,034 | 14,551 | 2,582 | 15,035 | 16,581 | 1,127 |
| Teachers' average experience (in years) | | | | | | | | | | |
| Local | 10.4 | 11.4 | 1.22 | 7.7 | 10.5 | 9.3 | 2.32 | 8.3 | 9.94 | 1.47 |
| Total | 13.9 | 14.07 | 1.64 | 9.3 | 12.3 | 12.0 | 2.73 | 11.2 | 12.65 | 1.55 |
| Cost/member | 2,469 | 2,458 | 333 | 2,117 | 2,350 | 2,305 | 226 | 2,197 | 2,417 | 191.45 |
| Cost/member less transportation | 2,357 | 2,409 | 327 | 1,993 | 2,226 | 2,135 | 201 | 2,048 | 2,314 | 234.08 |
| Equalized valuation/member | 93,254 | 117,260 | 39,001 | 82,308 | 113,360 | 92,143 | 25,214 | 83,619 | 94,148 | 26,143 |

School Characteristics

The general characteristics of the four schools outlined in Table 1.4 indicate that they were similar in enrollment but dissimilar in physical plant and organizational patterns. Schools 1 and 2 were housed in traditional plants (i.e., completely separate self-contained classrooms joined by common hallways), except for a new wing in School 1 containing an open space area for grades 5 and 6. Although the teachers in School 1 were nominally organized into multigrade teams, planning and instruction took place on a graded basis with a few exceptions; for example, in Year 3 of the study some fifth graders were in mathematics and science classes with sixth graders. School 2 was organized in a traditional graded manner; the only exception occurred in Year 2 in which some fourth graders were placed in fifth grade mathematics classes. Ability groups within a grade level were formed each year for some subjects at both Schools 1 and 2. These groups were essentially permanent except in language arts at School 1 in Year 1.

In Schools 3 and 4, students were placed in multigrade instructional units in large open areas with movable walls, chalkboards, and bookshelves. Cross-grade planning and grouping practices occurred at both schools during all three years; however, implementation of an individualized model of instruction was carried out most fully at School 3 where grouping across grades was utilized in most subject areas and regrouping occurred as needed. That is, for a particular subject over the course of a year, a student in School 3 was likely to have several different teachers and to be placed in a subgroup with children from more than one grade level according to common instructional needs. In School 4, cross-grade instructional planning and grouping was used extensively, but the groups tended to remain stable once established with some exceptions for a particular subject and/or year.

Student Characteristics

General background characteristics of the students who comprised the sample are presented in Table 1.5. Characteristics such as pre-school enrollment which remained more or less constant regardless of yearly fluctuations in the sample size are reported once for the entire sample. Characteristics of the group which changed yearly, such as participation in special services, are given on an annual basis. Base-line achievement test data were collected for the students but will be reported elsewhere.

The number of students recorded in the first row of Table 1.5 for each school refers to the total number of students included in the study at any time. Most of these students entered the first year but a few enrolled as fourth graders. Due to general attrition, the entry of a few new students in fourth grade, and a change in attendance boundaries at one school, the number of students in each year of data collection varied as shown. Because parental consent was required for certain aspects of the study (for example, use of achievement test data), certain analyses were performed with fewer students.

Table 1.4

CHARACTERISTICS OF THE FOUR SCHOOLS IN WHICH THE STUDY WAS CONDUCTED

| | School 1 | School 2 | School 3 | School 4 |
|-------------------------------|--|--|--|--|
| Days of Instruction | | | | |
| Year 1 | 176 | 180 | 179 | 178 |
| Year 2 | 177 | 180 | 179 | 180 |
| Year 3 | 175 | 178 | 179 | 180 |
| Enrollment | | | | |
| Year 1 | 577 | 484 | 512 | 456 |
| Year 2 | 607 | 454 | 493 | 476 |
| Year 3 | 553 | 363 | 481 | 440 |
| Grades enrolled | K-6 | K-6 | K-6 | K-6 |
| Physical plant | traditional, self-contained classrooms, except for new open space gr. 5-6 wing | traditional, self-contained classrooms | open space | open space |
| Organizational pattern | primary unit (gr. K-2) intermed. unit (gr. 3-4) upper unit (gr. 5-6) | K-6, graded | primary unit (gr. K-3) intermed. unit (gr. 3-5) upper unit (gr. 5-6) | kindergarten, graded primary unit (gr. 1-2) intermed. unit (gr. 3-4) upper unit (gr. 5-6) |
| Other | Art, music, and physical education are taught by regular classroom teachers, not special teachers. | | | |

Table 1.5
BACKGROUND CHARACTERISTICS OF STUDENT SAMPLE

| | School 1 | School 2 | School 3 | School 4 | Total |
|---|----------|------------------|----------|----------|-------|
| <u>Entry Characteristics</u> | | | | | |
| N | 88 | 63 | 51 | 79 | 281 |
| Age in months, fall, 1979 (\bar{x}) | 102 | 101 | 102 | 103 | 102 |
| Males (%) | 51 | 51 | 63 | 54 | 54 |
| Nonwhite (%) | 5 | 3 | 2 | 0 | 3 |
| Preschool attendance (%) | 20 | 39 | 28 | 27 | 28 |
| Aptitude (\bar{x}) | 116 | 104 ^a | 116 | 115 | 113 |
| <u>By-Year Characteristics</u> | | | | | |
| N | | | | | |
| Year 1 | 74 | 56 | 43 | 70 | 243 |
| Year 2 | 78 | 55 | 47 | 69 | 249 |
| Year 3 | 61 | 50 | 45 | 61 | 217 |
| Special services enrollment (%) ^b | | | | | |
| Year 1 | 18 | 18 | 16 | 6 | 14 |
| Year 2 | 14 | 13 | 19 | 4 | 12 |
| Year 3 | 5 | 8 | 9 | 3 | 6 |
| Days present (\bar{x}) | | | | | |
| Year 1 | 168 | 174 | 172 | 172 | 171 |
| Year 2 | 170 | 175 | 173 | 173 | 173 |
| Year 3 | 167 | 173 | 174 | 175 | 172 |

^aData are from the Test of Cognitive Skills (1982), given in fall, 1983, when students were in sixth grade; for the other three schools, scores are from a grade 2 administration of the Otis-Lennon Mental Ability Test (1973).

^bA student is counted once, regardless of the number of special programs in which s/he was enrolled.

The student populations of the four schools were comparable on most of the dimensions outlined in Table 1.5. Although a notable exception appears to be aptitude level at School 2, these data must be viewed with caution since the only scores available for School 2 were from a test given after completion of the study using an instrument different from the one used in the other schools. Data for the other three schools were from baseline testing in grade 2.

Attendance at preschool varied somewhat among the four schools, with the fewest students attending at School 1 and the most at School 2. Although higher preschool enrollment at School 2 might be related to lower aptitude, this conjecture is not borne out in the special services enrollment. That is, a comparable proportion of School 2 students received special services such as Title I reading and math programs, remedial or learning disability programs, general special education, or speech and hearing instruction. Special educational services were received by somewhat fewer students at School 4. No ready explanation is available for the high proportion of male students at School 3.

Teacher Characteristics

Background information for teachers who provided instruction for the students in the study is presented in Table 1.6. Since analysis of students' achievement primarily concerned their performance in regular academic areas, teacher characteristics are given only for teachers of academic subjects. Some teachers are represented in the data for two and occasionally for all three years. That is particularly true for Schools 3 and 4 which operated on a multigrade unit basis, so that some or all of the teachers taught students in the study for two or three consecutive years. The extreme case occurred at School 4 in which all six of the academic subject teachers in Year 1 continued in Year 2.

Table 1.6 indicates that, for the population as a whole, the teachers of regular academic subjects in the third grade were predominantly female, were less often female in the fourth grade, and at the fifth-grade level were equally divided among males and females. The proportion of academic subject teachers who held master's degrees increased over the three grades from about one-fourth to one-half of the teachers. This change in part reflected the increasing number of male teachers. On a school basis, the proportion of female teachers was roughly comparable in the four schools, although there were some differences from year to year. The proportion of teachers holding master's degrees ranged from about one-fourth of the teachers at School 3 to about one-half of the teachers at School 4. School 4 was the only one in which a significant number of third- and fourth-grade teachers held a master's degree. (However, one must bear in mind the fact that in School 4 the same team of teachers taught both third and fourth grades.)

For the total population, teachers of academic subjects averaged over 10 years of experience for each year of the study. On the whole, teachers in School 4 were younger and less experienced than teachers in the other schools, and the range of ages (30-42) was considerably less in School 4 than in the other schools.

Table 1.6
 BACKGROUND CHARACTERISTICS OF TEACHERS
 OF REGULAR ACADEMIC SUBJECTS

| School | Year | N ^a | Female | Master's degree held | Age | | | Total Years of Experience | | |
|--------------------|------|----------------|--------|----------------------------|------|------|-------|------------------------------|------|-------|
| | | | | | Mean | S.D. | Range | Mean | S.D. | Range |
| 1 | 1 | 4 | 4 | 0 | 45.0 | 15.8 | 29-61 | 11.7 | 6.6 | 6-18 |
| | 2 | 3/1 | 3 | 0 | 44.7 | 16.4 | 26-57 | 9.7 | 8.0 | 2-18 |
| | 3 | 5 | 1 | 5 | 44.5 | 13.0 | 33-63 | 14.4 | 8.8 | 8-29 |
| 2 | 1 | 2 | 2 | 0 | 47.5 | 10.6 | 40-55 | 11.0 | 5.7 | 7-15 |
| | 2 | 4 ^b | 2 | 1 | 35.0 | 7.3 | 25-42 | 7.5 | 4.6 | 2-13 |
| | 3 | 3/1 | 2 | 2 | 42.3 | 4.2 | 39-47 | 14.0 | 3.5 | 10-16 |
| 3 | 1 | 5 | 4 | 0 | 34.6 | 13.6 | 25-58 | 10.2 | 10.2 | 3-28 |
| | 2 | 6/3 | 4 | 2 | 41.7 | 15.6 | 25-59 | 14.0 | 11.4 | 1-29 |
| | 3 | 11/5 | 7 | 3 | 39.8 | 12.7 | 26-60 | 11.3 | 9.8 | 2-30 |
| 4 | 1 | 6 | 4 | 4 | 33.8 | 3.8 | 31-41 | 8.7 | 3.3 | 6-14 |
| | 2 | 6/6 | 4 | 4 | 34.8 | 3.8 | 32-42 | 9.7 | 3.3 | 7-15 |
| | 3 | 4 | 2 | 1 | 34.7 | 5.0 | 30-40 | 8.7 | 6.2 | 5-18 |
| Total ^c | 1 | 17 | 14 | 4 | 38.3 | 11.8 | 25-61 | 10.1 | 6.4 | 3-28 |
| | 2 | 19/10 | 13 | 7 | 38.6 | 11.3 | 25-59 | 10.6 | 7.5 | 1-29 |
| | 3 | 23/6 | 12 | 11 | 40.1 | 10.7 | 26-63 | 11.9 | 8.3 | 2-30 |

^aNumbers to the right of the slashes indicate the number of teachers who had been present the previous year; for example, 1 of the 3 teachers from School 1 in Year 2 had participated in the study in Year 1.

^bData were not available for a fifth teacher who participated.

^cData are available for 43 of the 44 academic subject teachers who took part in the study. Because some of the teachers participated for two or three years, the apparent number of participating teachers over the three years is 59.

Methodology and Instrumentation

After consent forms were secured from parents and school personnel, data collection proceeded during the three-year period according to the schedule outlined in Table 1.7. Information was gathered on variables in three general areas: student, teacher, and schoolwide variables. The major dependent variables for which data were collected were student achievement in reading and mathematics and student affective behavior. Information on student classroom behaviors was utilized to create both dependent and independent variables. All other data collected were used to form independent variables. A description of each instrument follows.

Student Variables

Information about individual students' personal, educational, and home background was assembled using the Student Personal Background Record and the Parent Interview. Student use of time in school was measured by means of the Student Classroom Observation Form. The Stanford Achievement Tests and the Self-Observation Scales (Katzenmeyer & Stenner, 1975) were used to assess academic progress and affective change during the study.

Student Personal Background Record. Basic information concerning each student's personal characteristics such as age, sex, race, handicaps (if any), and previous educational experiences such as preschool enrollment were ascertained from school cumulative records. Attendance data and records of involvement in special services programs were obtained annually. Baseline achievement and aptitude test scores were recorded using the most recent administration date prior to the study. Baseline test dates ranged from midyear of grade 1 at School 2 to fall of grade 3 at School 3. In all but School 2 the Stanford Achievement Tests and the associated Otis-Lennon Tests of Mental Ability had been administered. At School 2 the Comprehensive Tests of Basic Skills and the CTB Test of Cognitive Skills were used; as previously discussed, the latter test was not baseline and in fact was given after the study. However, because it was the only source of aptitude data for the school, the scores were incorporated in the student records. In Table 1.8 the testing sequence, baseline through posttest, is summarized.

Parent Interview. The purpose of the parent interviews was to accumulate information about students' daily activities at home, i.e., out-of-school uses of time such as homework or TV viewing, and about a wide range of background variables including family structure and socioeconomic status, parents' educational level and occupational status, the availability of reading resources in the home, frequency and type of contact with the school, and general attitude toward the school. The intent was to interview by telephone about one-third of the parents each year of the study. Although a concerted effort was made to contact all parents, the final sample was 199 interviews of a potential 281 families. In part this was due to families not yet sampled moving away after the first (or second) year of the study.

Table 1.7
INSTRUMENTATION AND SCHEDULE OF DATA COLLECTION

| Instrument | Administration Schedule |
|--|---|
| <u>Student Variables</u> | |
| Student Personal Background Record | once upon entry, updated annually |
| Parent Interview | once, one-third of the families each year |
| Student Classroom Observations | three classes annually per student per academic subject (reading, language arts, mathematics, science, social studies); as time permitted, classes in other subjects (art, music, physical education, special services) |
| Stanford Achievement Test | annually, end of year |
| Self-Observation Scales | annually, end of year |
| <u>Teacher Variables</u> | |
| Teacher Personal Background Record | once upon entry, updated annually if teacher participated for more than one year |
| Teacher Background, Preferences, and Opinions Questionnaire | once |
| Purdue Teacher Opinionaire | once |
| Teacher Time Allocation Record | three weeks annually |
| <u>School and School District Variables</u> | |
| Principal Personal Data Questionnaire | once, updated annually |
| Leader Behavior Description Questionnaire | once |
| School Data Questionnaire | once, updated annually |
| Instruction and Instruction Related Expenditures Form | annually (for each school staff member) |
| FTE/Pupil Count for Instructional/Noninstructional Personnel Form | annually |
| Individual Student FTE Assignments and Costs Form | annually |
| Gross and Operating Expenditure Data Form for Wisconsin/Non-Wisconsin School Districts | annually |
| Material, Equipment, and Physical Resources Form | annually (for each building) |

Table 1.8
ACHIEVEMENT, ATTITUDE, AND APTITUDE TESTS FOR THE STUDY

| Year of Study | School | Test | Test Date | Norms | Administrators | Notes |
|---------------|---------|---|---|---|----------------|--|
| Baseline | 1 | Stanford Achievement Test Primary Level II, Form A | March, 1979 | end of grade 2 | local staff | |
| | 2 | Comprehensive Tests of Basic Skills Level B, Form S | Feb., 1978 | mid grade 1 | local staff | |
| | 3 | Stanford Achievement Test Primary Level II, Form A | Sept., 1979 | beg. grade 3 | local staff | Scores were converted to end of grade 2 norms. |
| | 4 | Stanford Achievement Test Primary Level I, Form A | Oct., 1978 | beg. grade 2 | local staff | |
| 1 | 1, 2, 4 | Stanford Achievement Test Primary Level III, Form A | April/May, 1980 | end grade 3 | project staff | |
| | 3 | Stanford Achievement Test Primary Level III, Form A | Sept., 1980 | beg. grade 4 | local staff | Scores were converted to end of grade 3 norms. |
| 2 | 1, 2, 4 | Stanford Achievement Test Intermed. Level I, Form A | May, 1981 | end grade 4 | project staff | |
| | 3 | Stanford Achievement Test Intermed. Level I, Form A | Sept., 1981 | beg. grade 5 | local staff | Scores were converted to end of grade 4 norms. |
| 3 | 1-4 | Stanford Achievement Test Intermed. Level II, Form A | April, 1982 | end grade 5 | project staff | |
| 1-3 | 1-4 | Self-Observation Scales (SOS), Form A (Yrs. 1 and 3) Form C (Yr. 2) | April/May, 1980 (Yr. 1) May, 1981 (Yr. 2) April, 1982 (Yr. 3) | NCS national norms for the Intermediate level of the test | project staff | |
| Baseline | 1 | Otis-Lennon Mental Ability Test (OLMAT) | March, 1979 | Per chronological age | local staff | |
| | 2 | CTB Test of Cognitive Skills, Level 3, 1981 | October, 1982 ^a | " | local staff | If data were not available for the baseline test date (e.g., students were absent, or students entered the study the second year), then whatever recent aptitude data were available were coded. |
| | 3 | Otis-Lennon Mental Ability Test (OLMAT) | January, 1979 | " | local staff | |
| | 4 | Otis-Lennon Mental Ability Test (OLMAT) | February, 1979 | " | local staff | |

^aSchool 2 had declared a moratorium on aptitude testing until fall, 1982. These data were used because they were the only scores available.

Student Classroom Observations. The use of time in school by individual students was recorded by the research team using a Student Classroom Observation Form designed for the study. Each student was observed the equivalent of three full school days yearly over the course of annual fall, winter, and spring visits. The project staff was too small to permit the observation of only one student at a time; thus, it was not possible to actually observe every student during every minute of his or her day. Rather, the observations were organized by subject with highest priority given to obtaining complete observations in reading and mathematics; the next priority was assigned to the other academic subjects (language arts, science, and social studies); and lowest priority was accorded art, music, physical education, and special services.

Each observer observed five students simultaneously, and at two-minute intervals characterized each individual's use of time by using one of the following eight categories: on-task independent study, on-task one-to-one instruction, on-task small-group instruction, on-task large-group instruction, on-task study with one or more peers, off-task, process behavior, or nonobservable. The latter three categories exemplified off-task behavior but were distinguished by causal factors. "Off-task" indicated that the student could have been on-task in one of the preceding modes (e.g., small-group instruction) but instead was visiting, playing, daydreaming, or in some other fashion exhibiting nonattentive behavior. "Process behavior" usually referred to a waiting period when the student, due to factors outside his or her control, was forced to wait for the teacher to begin the class, correct a paper, or give noninstructional directions to the class, etc. The "nonobservable" category was used when a student left the classroom for some reason.

At least three days of observation were completed in reading and mathematics classes for 231 students in grade 3, 241 students in grade 4, and 205 students in grade 5. Longitudinal profiles over the three years were available for about 185 students.

Stanford Achievement Test. The major dependent variables in the study, student achievement in reading and mathematics, were measured by the Stanford Achievement Test at the end of each school year. The test forms appropriate to the grade level were administered as outlined in Table 1.8 and, although some students were given the entire battery upon the school's request, only results of the reading and mathematics tests were of interest in the study. The subtests for reading and mathematics contained in the battery are: reading comprehension, word study skills, mathematics concepts, mathematics computation, and mathematics applications. With the exception of School 3, the tests were administered by project staff and were handscored. School 3 conducted its own testing program, used the scoring service of the publisher, and then provided data to the research staff. Scores recorded were based on national norms and included raw scores, scale scores, stanines, percentiles, and grade equivalents. As Table 1.9 shows, performance on the various subtests of a subject test was highly correlated across subtests and with the total test, and agreed with the publisher's expected correlations; therefore, total test scores were used in the analyses. Except for occasional absentees and a few students who lacked parental consent, all students in the study participated in the testing program.

Table 1.9
CORRELATIONS AMONG ACHIEVEMENT TEST SCALE SCORES¹
FOR THE STUDY SAMPLE AND STANDARDIZATION SAMPLE¹

| | Year 1 | | Year 2 | | Year 3 | |
|-----------------------------|--------|-----------|--------|-----------|--------|-----------|
| | Study | Standard. | Study | Standard. | Study | Standard. |
| READING | | | | | | |
| Comprehension/Study Skills | .67 | .78 | .61 | .69 | .63 | .73 |
| Comprehension/Total Reading | .88 | .96 | .86 | .93 | .90 | .94 |
| Study Skills/Total Reading | .94 | .93 | .93 | .91 | .91 | .92 |
| MATHEMATICS | | | | | | |
| Concepts/Computation | .61 | .69 | .66 | .72 | .72 | .77 |
| Concepts/Applications | .72 | .76 | .72 | .76 | .76 | .79 |
| Computation/Applications | .63 | .68 | .68 | .68 | .77 | .76 |
| Concepts/Total Math | .89 | .91 | .91 | .90 | .90 | .91 |
| Computation/Total Math | .83 | .88 | .86 | .89 | .90 | .92 |
| Applications/Total Math | .91 | .91 | .90 | .91 | .93 | .93 |

¹Source: Technical Manual, Stanford Achievement Tests (1973).

Self-Observation Scales. The other set of dependent variables consisted of the seven dimensions of affective behavior measured by the Self-Observation Scales (Katzenmeyer & Stenner, 1975) which, according to the authors, represent "a wide range of self-concept behaviors with emphasis on self in relation to significant others in the individual's environment." The seven scales are: self-acceptance, self-security, social maturity, social confidence, peer affiliation, school affiliation, and teacher affiliation. The tests were administered by project staff following the schedule in Table 1.8 and were scored by the publisher. Standard scores (T scores), stanines, and percentiles were provided for each student on each dimension. As with the achievement tests, there was nearly full participation in the affective test program except for minor absenteeism and a few cases where parental permission was lacking.

Teacher Variables

Information about the personal, educational, and professional background and activities of all teachers in the study was obtained using the Teacher Personal Background Record. Further background information, attitudinal data about their profession, and self-report data about instructional practices were gathered from academic subject teachers by means of a Teacher Background, Preferences, and Opinions Questionnaire and the Purdue Teacher Opinionnaire (Bentley & Rempel, 1980). A summary of the amount of time devoted to each aspect of in-school and out-of-school professional life was assembled from the Teacher Time Allocation Records completed by each academic subject teacher.

Teacher Personal Background Record. All teachers, both academic subject and special subject, who had contact with the students in the study were requested to complete a questionnaire providing data on characteristics such as age, sex, undergraduate and graduate institutions attended, degrees held, participation in continuing education, involvement in professional and community organizations and activities, type and number of years of experience, and reasons for placement at the school and grade/subject. The questionnaire was completed when the teacher joined the study and, for major variables such as degree attainment, was updated annually thereafter. All except one of the 44 teachers of academic subjects completed the questionnaire; the results for these teachers are shown in Table 1.7. Teachers of special subjects such as art, music, physical education, learning disabilities and the like had only a tangential involvement in the study; 13 of these 27 teachers completed the questionnaire.

Teacher Background, Preferences, and Opinions Questionnaire. Academic subject teachers provided further personal information such as parental education and employment and the location of previous teaching positions in the first section of the Teacher Background, Preferences, and Opinions Questionnaire. This questionnaire was adapted for the project from an instrument administered in conjunction with a federally funded welfare reform experiment (Murnane & Phillips, 1979). On the

second section of the questionnaire, the teachers indicated their preferences, if any, for teaching particular socioeconomic and ability levels of students and provided ratings of the ability and effort of the groups of students they actually taught. In addition, they responded to a variety of questions describing practices such as use of pretesting, homework, competition, grading, and handling discipline matters. On the third section of the questionnaire, 43 5-point Likert scale items assessed the teachers' opinions and beliefs about a wide range of areas including the purpose of schooling, the role of teachers and students, instructional techniques, classroom management, and the like. Of the 44 academic subject teachers, 37 completed this questionnaire.

Purdue Teacher Opinionnaire. Job satisfaction of the academic subject teachers was assessed by the Purdue Teacher Opinionnaire (Bentley & Rempel, 1980). The Opinionnaire provides a total measure of job satisfaction as well as 10 subscores for the following factors: teacher rapport with principal, satisfaction with teaching, rapport among teachers, teacher salary, teacher load, curriculum issues, teacher status, community support of education, school facilities and services, and community pressures. Data on the Opinionnaire were gathered for 35 of the 44 academic subject teachers and scored by the publisher, who provided a median rating and a percentile rank for each factor by teacher and by school based on national norms for the instrument.

Teacher Time Allocation Record. For three representative weeks during the fall, winter and spring of each year of the study, teachers of academic subjects were requested to maintain a log of their professional activities, both in and out of school. The activities included direct instruction as well as responsibilities such as supervision, planning and preparation, tutoring, clerical work, testing, parent-teacher conferences, socializing (professional), and record keeping. The length of the time block, the number of students, the subject, the mode of instruction such as small- or large-group, and the number of adults were recorded for all instructional activities. This information was utilized to validate data gathered in the classroom observation phase of the study. For time spent in activities other than direct instruction, teachers also were asked to provide relevant details such as the number of students (if any), the subject (if any), the location of the activity, etc. Most of the academic subject teachers, 37 of 44, completed the Teacher Time Allocation Records; the majority also provided information for all three weeks, although eight of the 37 finished the record only for one or two weeks. Most teachers who were members of units which participated in the study for more than one year were requested to complete new forms for each year.

School and School District Variables

General information about the principals of the four schools, such as educational and professional background and a profile of each principal's leadership qualities as perceived by the teaching staff, were obtained, respectively, from the Principal Personal Data Questionnaire and the Leader Behavior Description Questionnaire (Halpin, 1957). The

School Data Questionnaire was used to gather and record general facility and personnel information for each school. The data used to allocate expenditures for instruction and related activities to individual students were developed by means of a series of forms: Instruction and Instruction Related Expenditures; FTE/Pupil Cost for Instructional/Noninstructional Personnel; and Individual Student FTE Assignments and Costs. Additional cost data which were fixed with regard to individual students were collected on two forms: Gross and Operating Expenditure Data for Wisconsin School Districts; and Material, Equipment, and Physical Resources Available to Students.

Principal Personal Data Questionnaire. Each principal completed a questionnaire describing his personal, educational, and professional background, including age, sex, educational institutions attended, degrees held, current educational status, professional and community organizations and activities, years of experience in teaching and administration, reasons for current placement, etc. Data were collected from five principals because a new principal entered the study in Year 3 at School 2. Major variables, such as degree attainment, were updated annually.

Leader Behavior Description Questionnaire. The Leader Behavior Description Questionnaire (Halpin, 1957) is an instrument containing 40 items describing ways in which a leader may behave. Group members use a 5-point scale to indicate the frequency with which the leader engages in each type of behavior, and the questionnaire is then scored on two dimensions: Initiating Structure and Consideration. Initiating Structure refers to various aspects of the leader's job, such as role delineation and establishment of patterns of organization and channels of communication. Consideration refers to relationships between the leader and group members in areas such as friendship, trust, respect, and warmth. During the third year of the study, all staff members in each school completed the Leader Behavior Description Questionnaire for their building principal.

School Data Questionnaire. General facility and personnel information for each school was recorded by the building principal on the School Data Questionnaire. The data included age of and additions to the building; area of the building and playground; length of the school day and year; number of early dismissal and inservice days; number of part-time and full-time teachers, aides, interns, and administrators; involvement of minority students and staff; and standardized test and progress report procedures.

Instruction and Instruction Related Expenditures Form. The purpose of this form was to record the cost per Full Time Equivalent (FTE) student for each employee who provided direct or indirect instruction to students. Yearly salaries and fringe benefits for (1) teachers and staff directly involved with teaching students in each school; (2) administrators and supervisors of educational programs in the school; and (3) contiguous faculty in the school such as guidance, instructional materials, and library personnel were collected from central office records, building records, and/or the individuals involved and recorded on the form for each of the three years of the study. The total number

of FTE students for each teacher and the pupil count for each administrator, supervisor, and contiguous faculty also were calculated and recorded on the FTE/Pupil Count for Instructional/Noninstructional Personnel form. The cost per FTE student for teachers and the cost per student for other staff were then determined by dividing the yearly total of the salary and fringe benefits by the FTE or pupil count as follows:

$$\frac{\text{salary + fringe}}{\text{FTE count}} = \text{cost per FTE student}$$

The resulting figure was recorded and utilized to develop cost-of-instruction figures for individual students on the Individual Student FTE Assignments and Costs Form.

FTE/Pupil Count for Instructional/Noninstructional Personnel Form.

The FTE count for teachers and pupil counts for other staff included on the Instruction and Instruction Related Expenditures form explained above were calculated and recorded on the FTE/Pupil Count for Instructional/Noninstructional Personnel form according to the following procedures. For each year of the study, a "standard day" was determined for each school; that is, the standard number of minutes each day teachers were normally expected to work with or maintain contact with pupils was calculated by examining each teacher's weekly schedule, totaling all minutes of pupil contact for the five days for each teacher, obtaining a daily average per teacher, and then averaging across all teachers for the grade (or unit) level to determine a single standard day for the school. Since the standard school day included the time students were in art, music, and physical education, the same standard day length was also assigned to these teachers. (A separate standard day for special services teachers was developed since they had variable schedules.) The standard school day also included time allotted to general academic areas such as library skills. Time for recess, lunch, homeroom, and similar duties was excluded from the standard school day.

A standard school year also was determined for each school for each year. This figure was simply the total number of days teachers were expected to work with or maintain contact with pupils. Inservice days, snow days, etc., were not included.

Using the standard day and standard year information in conjunction with three other variables (the number of students taught per subject per day, the length of the class per subject per day, and the number of days of class per subject per year), the FTE count for each subject (i.e., unit of instruction) for each teacher was calculated using the formula:

$$\frac{\text{length of daily class}}{\text{length of standard day}} \times \frac{\text{number of days class taught}}{\text{number of days in standard year}} \times$$

number of students = FTE count

The FTE counts for each subject the teacher taught were then summed to create a total FTE count for that teacher. For other staff members such as administrators, supervisors, librarians, and counselors, for whom pupil contact time could not be determined, a general pupil count was recorded. This was simply the total number of students served by these staff members.

The total FTE and pupil counts were transferred to the Instruction and Instruction Related Expenditures form and divided into the salary and fringe benefit figures to create an FTE cost per student for each staff member. The FTE costs for teachers and other staff were in turn used to develop per-pupil costs of instruction on the Individual Student FTE Assignments and Costs form.

Individual Student FTE Assignments and Costs Form. This form was utilized to record the yearly schedule of each student in each year of the study and to determine the cost of direct instruction in each subject (e.g., reading, mathematics) on the schedule, the yearly total cost of direct instruction, and the yearly grand total of direct and indirect instructional costs. Teachers' schedules and classroom observation data were used to ascertain the student's schedule, including the minutes per day, days per year, and instructor for each subject (i.e., unit of instruction).

Parallel to the procedure followed to develop each teacher's FTE count, each student's proportion of the total standard day and standard year was calculated for each subject. The resulting figure was multiplied by the FTE cost per student for the teacher providing instruction (derived from the Instruction and Instruction Related Expenditures form) to determine the instructional cost. In summary, the formula is:

$$\frac{\text{minutes per day}}{\text{length of standard day}} \times \frac{\text{days per year}}{\text{length of standard year}} \times \frac{\text{cost per FTE student for this teacher}}{\text{instructional cost per student per unit of instruction}}$$

The instructional costs for each subject (unit of instruction) were summed to provide the total cost for direct instruction for the student for the year. Indirect costs per student for supervisory and administrative personnel and for contiguous support staff such as librarians and counselors, as developed on the Instruction and Instruction Related Expenditures form, were recorded and then added to the direct costs, and, finally, a total yearly cost per pupil was calculated.

Gross and Operating Expenditure Data Form for Wisconsin/Non-Wisconsin School Districts. Gross and operating expenditure data for the four districts were collected each year, either from the fall budget reports or the school district annual reports, and per-pupil gross and operating costs based on average daily membership (ADM) were calculated by means of this form. Data for non-Wisconsin school districts of the same size also were collected for purposes of comparison.

Material, Equipment, and Physical Resources Form. Per-pupil costs were calculated and recorded on this form for physical and consumable resources such as paper and pencils, classroom and/or unit instructional resources such as reference books, library or IMC resources such as books, and equipment resources such as computers and reproduction machines.

Data Analysis

The data analysis for the various components of the study proceeded in three interrelated but discrete stages. First, general descriptive statistics were determined for the data from each instrument on a cross-sectional basis for each school and year, and for the sample as a whole. At this stage, anomalies, errors, and critical missing data were identified, and problems were rectified where possible. Scatter plots and stem-leaf displays were used to examine the nature of the distribution for variables of particular interest.

Secondly, relationships between the set of independent variables from each instrument and the major dependent variables, achievement and self-concept, were explored for each school and year, and for the total population by means of simple correlation, multiple regression analyses, and factor and cluster analyses. Variables used in the regression analyses and in many of the other analyses were standardized. These analyses were performed on a cross-sectional basis by year (and sometimes by school) for all variables examined, as well as on a longitudinal basis for selected variables. In addition to this report, results from analyses relating data for time-on-task variables from the classroom observations and the dependent variables have been reported (Rossmiller, 1981, 1982a, 1982b, 1982c, 1983a, 1983b, 1983c). Other results have been reported in a series of doctoral dissertations (Broaden, 1980; Frank, 1982; Hassenpflug, 1981; Jacobson, 1980; Lisi, 1982; Martin, 1982; Olson, 1985; Verstegen, 1983).

During the third stage of the analyses, variables from the second stage determined to be most closely related to achievement were used in principal components and multiple regression analyses to detect associations in the regressors and their relative effect upon student achievement. These analyses were performed on both a cross-sectional and longitudinal basis.

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SECTION II

TIME UTILIZATION AND STUDENT PERFORMANCE

Familiar adages such as "Time is money" and "A stitch in time saves nine" exemplify the importance attached to the efficient use of time by most Americans. In view of our cultural preoccupation with time, it is somewhat surprising that relatively little research has been directed to the use of time in American schools, and particularly to the educational consequences of various patterns of time usage. It is true, of course, that early in this century attempts were made to apply time management principles to education (Callahan, 1962), but whether or not these attempts produced any lasting changes in public schools is debatable. Surveys conducted during the 1920s revealed that the amount of instructional time allocated to various subjects differed widely among city school systems in the United States (Mann, 1928). However, the relationship between variations in the amount of instructional time devoted to various subjects and the learning outcomes of students was not identified. For the most part, interest on the part of researchers in the linkages between the use of time in school and student performance is of rather recent origin (Fisher & Berliner, 1985).

It is enticing to view time on-task as a primary determinant of student learning because it seems to offer such a simple way to solve the problem of poor student performance. If it is true that the more time students devote to studying a subject, the more likely they are to master it, it follows that the prescription for improving student performance is simple and straightforward--maximize the time students spend on-task and minimize interruptions and distractions that might divert their attention from the subject.

Karweit has noted that "the major theories that incorporate time as a variable in learning are based on two broad perspectives: an economic one, in which time appears as a resource to the educational process; and a psychological one, in which time appears as a mediating element in the teaching/learning process" (1982, p. 3). Carroll's (1963) model of learning and Bloom's (1976) "mastery learning" strategy are representative of the psychological approach in which time functions as a mediating element in student learning.

Much of the current interest in the way time is used in schools can be traced to Carroll's (1963) work. Carroll recognized students' time as an important resource in the learning process. He distinguished between elapsed time and student time on-task, defining on-task time as the time during which the student is "paying attention" and "trying to learn" (p. 725). Carroll acknowledged that the amount of time needed to learn is influenced by a student's aptitude and ability to understand and follow directions, and by the quality of instruction. Carroll's model of learning suggests that, ceteris paribus, learning is a function of the student's time on-task.

Bloom (1976) developed a strategy for "mastery learning" that draws upon Carroll's model of the relationship between time and learning. Bloom noted that in traditional teaching a high correlation exists between aptitude and student achievement because each student is allocated the same amount of instructional time. He argued that if sufficient time were provided, a vast majority of students could master the content that schools seek to teach. Thus, mastery learning strategy holds fixed the amount of material to be mastered and varies the amount of time available for learning based on the needs of individual students.

From an economic perspective, time is viewed as one of many school resources which, in combination with other resources, determines school productivity. For the economist, the task is one of determining how to maximize productivity given limited resources. As Thomas (1971) observed, the opportunity cost associated with alternative uses of student time is "foregone learning," not "foregone earning," at least at the elementary school level. Of course, at higher levels of schooling where students must give up a job in order to attend school, both "foregone learning" and "foregone earning" are involved in the opportunity cost of school time. From an economic perspective, student time is a particularly important variable because it is one over which educators can exercise considerable control, in contrast with variables such as household income or parents' level of schooling which are beyond the control of school authorities.

Micro Level Studies of School Time*

Although researchers examined the relationship between school time and student learning at the macro level (school system or state) early in the 1970s (Harnischfeger & Wiley, 1974), it is only recently that researchers have studied the use of time by individual students in classrooms. The research of Thomas and his colleagues at the University of Chicago focused on the use of time by individual students from an economic perspective. Thomas collected data from school districts, schools, classrooms, students, and homes representing 58 classrooms in 19 school districts in the Chicago metropolitan area (Thomas, Kemmerer, & Monk, 1982). Classrooms were selected from within school districts chosen by a stratified random sampling process in which three SES levels and two school district expenditure levels were considered. Eight students within each classroom were selected for close observation, with data obtained from a total of 233 students and 233 homes. Trained observers spent two or three weeks in each classroom observing fifth-grade classes in mathematics and social studies. Their observations

*A comprehensive review of studies of time usage in schools is beyond the scope of this section. Readers interested in such reviews are referred to Karweit (1982), Borg (1980), Frederick and Walberg (1980), or Fisher and Berliner (1985).

focused on the availability of resources, the use of teacher and student time, the structuring of activities, and the curricular materials and subject matter which formed the basis of classroom instruction. Parent interviews were conducted to identify human and material resources for learning that were available in the home.

Substantial differences were found across subjects, instructional formats, and SES categories in the percent of time during which students were on-task. Students in low- and high-SES classrooms showed a higher proportion of on-task time than did students in middle-SES classrooms. Instruction in small groups, individualized seatwork, and tutoring were characteristic of classrooms serving high-SES students and were not observed at all in classrooms serving low-SES students.

Monk (1979, pp. 29-30), based on an analysis of a subset of the above data concerning differences between and within classrooms, concluded:

1. Significant variation existed among students with respect to pupil-specific flow of human resources within classrooms.
2. Most of this variation among students in the flow of resources was attributable to differences between classrooms.
3. Classroom characteristics such as the mean and dispersion of test scores and the socioeconomic status of the students' fathers were strongly correlated with differences in the nature of the available supply of human resources within classrooms.
4. Most of the variation in resource flow within classrooms was attributable to differences among students in their level of engagement.
5. Even though the process by which some students received different resources relative to their classmates remained poorly understood, it appeared that the process was influenced by parents as well as by students.

Nature of the Current Study

This study examined the relationship between the allocation and use of time in elementary school classrooms and the cognitive outcomes exhibited by students. All students in each of four Wisconsin elementary schools in the third grade in 1979-80 were followed through their third-, fourth-, and fifth-grade school years. Two of the schools served medium-sized urban communities; the other two were located in small town/rural areas. Data reported in Section I indicate that students in the four schools were quite similar on most measures, and that the four school districts in which the schools were located were generally representative of Wisconsin school districts of similar size.

Each student was observed in the classroom at two-minute intervals throughout each of three days per year (fall, winter, and spring). The observer recorded the subject, the mode of instruction, and whether the student was on- or off-task or engaged in process behavior at the time of the observation. Students' academic progress was monitored annually by their performance on the reading and mathematics sections of the Stanford Achievement Test. The Self-Observation Scales also were administered annually to provide a measure of the affective development of each student.

Time on-task, which represents the time in which a student is actively engaged in learning, was categorized in one of five modes of instruction:

1. Independent study, in which the student was working alone--either reading, studying, writing, working with learning aids, working with other instructional materials, etc.
2. One-to-one, in which the student was working with an adult--a teacher, an aide, or a volunteer--but with no other students involved.
3. Small group, in which the student was working with an adult in a group smaller in size than the entire class.
4. Large group, in which the student was working with the teacher and other students in a class size or larger group.
5. With other student(s), in which the student was working with one or more other students but not with an adult.

In addition to time spent on-task in one of the five instructional modes, student use of time was classified in three other categories--process behavior, off-task time, and nonobservable time. Process behavior was defined as time when the student was in transition from one activity to another, waiting for instructions from the teacher before proceeding, obtaining directions, correcting test papers, or similar activities in which the student was not actively engaged in the learning task at hand. Off-task was defined as time when the student was not attending to the task at hand, or any other assignment, but was "wasting" time which could have been used constructively. The non-observable category covered periods when the student had left the room or was not within sight of the observer.

The Use of Time in Four Elementary Schools

Considering only the "academic subjects"--reading, mathematics, language arts, science and social studies--the amount of class time spent on these subjects dropped from an average of 209 minutes per day for third graders to 179 minutes per day for fourth graders and to 154 minutes per day for fifth graders (see Table 2.1). The decline in

minutes per day devoted to these five academic subjects was not a result of shorter school days; in fact, the total length of the school day increased from third grade to fifth grade. Rather, it reflects a growing amount of time devoted to other activities during the school day as students progress through the elementary grades, at least in these four schools.

Two instructional modes predominated. During the third-grade year, the average student was on-task 70 minutes per day in independent study and 57 minutes per day in large-group instruction; during the fourth-grade year, the average student was on-task 53 minutes per day in independent study and 70 minutes per day in large-group instruction; and during the fifth-grade year, the average student was on-task 44 minutes per day in independent study and 61 minutes per day in large-group instruction. An average of 18 minutes per day was spent in small-group instruction at the third-grade level, but this declined to 7 minutes and 6 minutes in fourth and fifth grade, respectively. Very little time was devoted to either one-to-one instruction or to work with other students in any of the three years.

Examining individual students, one finds considerable variation in the amount of time spent on-task in each instructional mode. In some instructional modes, at least one student was observed to spend no time at all on the task at hand. Other students were much more task oriented, spending most of their time on-task in each of the academic subjects.

It is disappointing to note that the average third grader in these four schools was on-task only about 72% of the time devoted to these five subjects, with 34 minutes per day spent in process time and 20 minutes per day in off-task time. The average student in the fourth grade was on-task about 75% of the time, with 21 minutes spent in process time and 20 minutes in off-task time. A similar pattern was found at the fifth grade, where the average student was on-task about 75% of the time, with 18 minutes in process time and 16 minutes in off-task time.

It would, of course, be unrealistic to expect all students to be on-task at all times. We know that individual students differ in their attention span, that some are more easily distracted than others, and that these individual differences are certain to influence the way in which a student uses classroom time. However, the amount of time devoted to process behavior is somewhat disappointing. Process behavior, as we have defined the term, is one indicator of the teacher's skill in classroom management. Time lost when a student is waiting for the teacher to correct a paper or to answer a question, or when the teacher repeats instructions over and over and over again, or when the teacher fails to start the class on time, are all part of process behavior.

Table 2.1

Use of Daily Instructional Time by Students in Five Subject Areas
(Reading, Mathematics, Language Arts, Science, and Social Studies)*

| | | Third Grade 1979-80(n=196) | Fourth Grade 1980-81(n=227) | Fifth Grade 1981-82(n=192) |
|-------------------|------|-------------------------------|--------------------------------|-------------------------------|
| Independent study | Ave. | 69.7 | 52.7 | 44.5 |
| | Hi. | 105.9 | 131.4 | 82.7 |
| | Lo. | 29.4 | 18.7 | 32.7 |
| One-to-one | Ave. | 1.9 | 1.7 | 1.0 |
| | Hi. | 11.3 | 14.4 | 8.7 |
| | Lo. | 0 | 0 | 0 |
| Small group | Ave. | 18.5 | 7.2 | 5.8 |
| | Hi. | 59.3 | 43.3 | 28.4 |
| | Lo. | 0 | 0 | 0 |
| Large group | Ave. | 57.2 | 69.6 | 60.9 |
| | Hi. | 117.4 | 115.1 | 94.7 |
| | Lo. | 16.7 | 9.0 | 16.7 |
| W/other students | Ave. | 4.1 | 2.5 | 3.5 |
| | Hi. | 22.0 | 18.3 | 22.7 |
| | Lo. | 0 | 0 | 0 |
| Total on-task | Ave. | 151.4 | 133.7 | 115.7 |
| Process time | Ave. | 34.1 | 20.7 | 17.7 |
| | Hi. | 60.0 | 38.6 | 32.2 |
| | Lo. | 15.3 | 5.3 | 4.7 |
| Off-task time | Ave. | 20.5 | 10.8 | 16.5 |
| | Hi. | 93.7 | 64.3 | 47.3 |
| | Lo. | 1.3 | 2.3 | 1.3 |
| Not observed | Ave. | 3.4 | 3.0 | 3.9 |
| | Hi. | 50.0 | 30.0 | 42.0 |
| | Lo. | 0 | 0 | 0 |
| Total class time | | 209.4 | 179.2 | 153.8 |

*Includes only students for whom observations were available for each of the five academic subjects.

Time On-Task by Mode of Instruction--Reading

Information concerning student reading performance and time on-task for each mode of instruction in reading is presented in Table 2.2. The data are reported for each school and for the total sample for each of the three years in which student observations were taken. The amount of instructional time devoted to process behavior also is shown. It will be noted that student performance in each of the four schools is at or above the national norm. (Wisconsin students typically score above the national norm on standardized achievement tests.) Students in Schools A, C, and D consistently scored higher than those in School B.

Two modes of reading instruction predominated in the third grade-- independent study and instruction in a small-group setting. In fact, these two modes of instruction accounted for 87% of the instructional time in reading, with very little time spent in either one-to-one or with-other-student modes. The amount of time students were on-task in reading averaged 45 minutes per day and ranged from 39 minutes per day in School A to 58 minutes per day in School C. Process time in periods of reading instruction averaged about 9 minutes per day, ranging from 7.5 minutes per day in School A to 10.6 minutes per day in School C.

At the fourth-grade level, independent study was still the most prevalent mode of instruction, averaging over 17 minutes per day. However, more use was made of large-group instruction which had increased to an average of about 15 minutes per day. The use of small-group instruction had declined to about 5 minutes per day. Instruction in the one-to-one and with-other-student modes was rarely observed. Time on-task in reading averaged about 40 minutes per day at the fourth-grade level and ranged from 31 minutes per day in School C to nearly 48 minutes per day in School D. Time spent in process activities averaged nearly 6 minutes per day, ranging from 4 minutes per day in School A to 8.3 minutes per day in School D. Time spent in process activities was about 12% of the time on-task in reading compared to over 20% spent in such activities during the third-grade year.

At the fifth-grade level, the average amount of time spent on-task in reading was 31 minutes per day and ranged from about 26 minutes per day in School B to nearly 38 minutes per day in School A. Independent study remained the most prevalent mode of instruction in reading, followed by large-group instruction and small-group instruction. Instruction in the one-to-one and with-other-student modes was seldom observed. Process time in reading averaged over 4 minutes per day with little variation among the schools. Process time continued to represent approximately 14% of the time on-task in reading.

Differences were evident in the time on-task in reading each year in the four schools. School A was most consistent in the time spent on-task in reading, averaging between 37 and 40 minutes per day for each of the three years. In School C, on the other hand, more than twice as much time was spent on-task in reading in grade three as in grade five. The use made of various modes of instruction also differed rather widely

Table 2.2
 Reading Performance and Time On-Task by Mode of Instruction in Reading
 by School and Total Sample: 1979-80, 1980-81, and 1981-82

| Year | N | Mode of Instruction | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|-----|---------------------|------|---------|------------|------|-------|-------------------|------|-------|------------|------|-------|-------------|------|-------|-------------|------|-------|------------------|------|-------|--------------|------|-------|
| | | Reading Performance | | | | | | Independent Study | | | One to one | | | Small Group | | | Large Group | | | w/Other Students | | | Process Time | | |
| | | Standard Score | | | Percentile | | | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range |
| <u>1979-80</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| School A | 72 | 153.0 | 17.1 | 119-198 | 65.8 | 26.7 | 8-99 | 22.0 | 9.6 | 5-43 | 0.3 | 0.4 | 0-2 | 10.6 | 5.5 | 0-29 | 5.2 | 4.9 | 0-16 | 1.4 | 2.0 | 0-7 | 7.5 | 3.2 | 2-14 |
| School B | 52 | 143.4 | 15.3 | 116-172 | 50.5 | 28.2 | 6-94 | 22.5 | 8.9 | 6-43 | 0.5 | 0.8 | 0-4 | 12.6 | 10.5 | 0-35 | 6.1 | 7.5 | 0-23 | 3.1 | 3.2 | 0-14 | 9.7 | 4.3 | 3-21 |
| School C | 38 | 154.2 | 13.1 | 134-181 | 69.1 | 20.1 | 32-98 | 33.1 | 11.3 | 10-55 | 1.6 | 2.1 | 0-11 | 19.0 | 8.2 | 3-36 | 3.4 | 3.6 | 0-11 | 0.8 | 1.8 | 0-9 | 10.6 | 5.2 | 4-26 |
| School D | 69 | 152.8 | 10.8 | 133-179 | 68.4 | 17.8 | 28-98 | 28.0 | 9.5 | 6-55 | 0.3 | 0.5 | 0-3 | 14.4 | 6.4 | 1-31 | 1.6 | 1.9 | 0-6 | 0.7 | 1.2 | 0-4 | 10.0 | 3.6 | 3-18 |
| Total | 231 | 151.0 | 14.9 | 116-198 | 63.7 | 24.6 | 6-99 | 25.7 | 10.5 | 5-55 | 0.5 | 1.1 | 0-11 | 13.6 | 8.1 | 0-36 | 4.0 | 5.1 | 0-23 | 1.5 | 2.3 | 0-14 | 9.3 | 4.1 | 2-26 |
| <u>1980-81</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| School A | 75 | 162.7 | 18.9 | 124-221 | 63.1 | 26.8 | 6-99 | 11.7 | 3.6 | 5-21 | 0.4 | 0.6 | 0-3 | 1.2 | 2.4 | 0-9 | 21.7 | 7.4 | 8-38 | 1.7 | 2.9 | 0-10 | 4.0 | 1.6 | 1-10 |
| School B | 52 | 154.7 | 19.6 | 123-197 | 51.6 | 30.7 | 4-99 | 15.2 | 7.4 | 2-28 | 0.6 | 1.1 | 0-7 | 12.7 | 14.0 | 0-49 | 11.9 | 7.2 | 0-25 | 0.2 | 0.5 | 0-3 | 5.3 | 2.1 | 1-9 |
| School C | 45 | 167.7 | 19.7 | 119-215 | 69.0 | 23.5 | 4-99 | 15.3 | 6.5 | 5-35 | 0.4 | 0.7 | 0-3 | 2.6 | 4.4 | 0-16 | 12.2 | 8.7 | 0-29 | 0.4 | 1.0 | 0-5 | 4.5 | 2.2 | 0-10 |
| School D | 69 | 158.6 | 20.3 | 107-215 | 56.7 | 26.7 | 2-99 | 26.9 | 12.6 | 8-68 | 1.0 | 2.0 | 0-13 | 6.4 | 9.4 | 0-36 | 11.1 | 6.5 | 0-23 | 2.1 | 3.7 | 0-11 | 8.3 | 2.9 | 3-16 |
| Total | 241 | 160.7 | 20.0 | 107-221 | 59.9 | 27.6 | 2-99 | 17.5 | 10.3 | 2-68 | 0.6 | 1.3 | 0-13 | 5.4 | 9.5 | 0-49 | 14.8 | 8.7 | 0-38 | 1.3 | 2.7 | 0-11 | 5.6 | 2.9 | 0-16 |
| <u>1981-82</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| School A | 57 | 172.7 | 16.5 | 143-215 | 64.3 | 21.7 | 20-99 | 21.2 | 7.6 | 9-37 | 0.4 | 0.8 | 0-4 | 2.0 | 7.9 | 0-9 | 14.2 | 8.2 | 2-36 | 0.1 | 0.5 | 0-3 | 4.3 | 1.8 | 1-12 |
| School B | 49 | 164.8 | 20.2 | 131-211 | 53.5 | 29.1 | 8-99 | 11.5 | 4.8 | 0-23 | 0.1 | 0.3 | 0-1 | 8.5 | 9.8 | 0-39 | 5.9 | 5.7 | 0-22 | 0.1 | 0.1 | 0-1 | 4.8 | 2.0 | 0-9 |
| School C | 44 | 175.7 | 16.9 | 146-215 | 68.6 | 21.4 | 24-99 | 11.8 | 6.7 | 0-21 | 0.2 | 0.4 | 0-2 | 0.8 | 3.1 | 0-12 | 13.3 | 6.6 | 6-39 | 1.1 | 3.3 | 0-13 | 4.6 | 2.4 | 1-11 |
| School D | 55 | 174.9 | 17.3 | 127-221 | 68.1 | 22.6 | 4-99 | 17.9 | 7.6 | 2-33 | 0.1 | 0.4 | 0-1 | 4.7 | 6.6 | 0-21 | 7.3 | 8.7 | 0-23 | 0.5 | 1.4 | 0-8 | 4.1 | 2.3 | 0-10 |
| Total | 205 | 172.0 | 18.1 | 127-221 | 63.7 | 24.4 | 4-99 | 16.0 | 8.0 | 0-37 | 0.2 | 0.5 | 0-4 | 4.0 | 6.8 | 0-39 | 10.2 | 8.3 | 0-39 | 0.4 | 1.7 | 0-13 | 4.4 | 2.1 | 0-12 |

50

2.8 57

among the four schools and varied from year to year within each school. These variations in the use made of instructional modes undoubtedly reflect teachers' decisions concerning their preferred modes of reading instruction.

Time On-Task by Mode of Instruction--Mathematics

Information concerning student performance and time on-task in various modes of instruction in mathematics is presented in Table 2.3. The data concerning student performance in mathematics again show School B lagging the other three schools. The average performance in all four schools, however, was at or above national norms.

Data for the third-grade year (1979-80) show that an average of about 33 minutes per day was spent on-task in mathematics instruction, and 10 minutes per day were spent in process behavior. The lowest amount of time on-task, 26 minutes per day, was observed in School D; the highest amount of time, over 38 minutes per day, was found in School A. Independent study and large-group instruction were the most common modes of instruction employed, with very little time spent in the other three modes. Process behavior represented 30% of the time in which students were on-task in mathematics.

At the fourth-grade level, students spent an average of about 32 minutes per day on-task in mathematics, with averages ranging from about 26 minutes per day in School D to over 40 minutes per day in School A. Independent study and large-group instruction again were the most common modes of instruction employed, with very little time spent in any of the other three modes of instruction. The average amount of process time declined to an average of about 6 minutes per day, which represented about 18% of the time spent on-task in mathematics.

The average amount of time spent on-task in mathematics instruction declined to 27.5 minutes per day in the fifth-grade year. Students in School A averaged nearly 34 minutes per day on-task in mathematics instruction, while those in School B averaged about 25 minutes per day. Independent study and large-group instruction were the predominant modes and, again, very little time was spent in the other three modes of instruction. Process time in mathematics averaged 4.5 minutes per day, representing approximately 16% of the time on-task in mathematics.

The differences among schools in mathematics instruction were smaller than in reading instruction. Larger variations occurred in the use of large-group instruction than in the use of independent study among the four schools. It is worth noting that very little use was made of small-group instruction in mathematics. Only one school (School B) made more than limited use of small-group instruction.

Table 2.3

Mathematics Performance and Time On-Task by Mode of Instruction in Mathematics
by School and Total Sample: 1979-80, 1980-81, and 1981-82

| Year | N | Mathematics Performance | | | | | | Mode of Instruction | | | | | | | | | | | | | | | | | |
|----------------|-----|-------------------------|------|---------|------------|------|-------|------------------------------------|------|-------|-----------------------------|------|-------|------------------------------|------|-------|------------------------------|------|-------|-----------------------------------|------|-------|-------------------------------|------|-------|
| | | Standard Score | | | Percentile | | | Independent Study (Minutes/day) | | | One to one (Minutes/day) | | | Small Group (Minutes/day) | | | Large Group (Minutes/day) | | | W/Other Students (Minutes/day) | | | Process Time (Minutes/day) | | |
| | | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range | Mean | S.D. | Range |
| 1979-80 | | | | | | | | | | | | | | | | | | | | | | | | | |
| School A | 72 | 149.3 | 13.2 | 119-180 | 61.9 | 28.2 | 4-99 | 22.0 | 6.7 | 8-36 | 0.5 | 0.6 | 0-3 | 0.4 | 0.9 | 0-5 | 15.1 | 7.7 | 2-35 | 0.5 | 0.7 | 0-4 | 14.1 | 5.1 | 7-27 |
| School B | 52 | 144.1 | 13.2 | 114-176 | 50.7 | 29.9 | 1-99 | 18.9 | 5.4 | 7-29 | 1.0 | 1.4 | 0-6 | 5.9 | 7.0 | 0-20 | 5.7 | 5.0 | 0-13 | 0.7 | 0.9 | 0-5 | 6.5 | 1.9 | 3-11 |
| School C | 38 | 147.9 | 9.7 | 134-183 | 59.9 | 21.0 | 23-99 | 18.5 | 7.6 | 4-39 | 0.8 | 1.1 | 0-4 | 1.4 | 2.9 | 0-10 | 13.3 | 7.3 | 0-34 | 3.1 | 4.4 | 0-17 | 9.8 | 3.7 | 4-19 |
| School D | 69 | 147.4 | 10.2 | 122-173 | 59.0 | 23.8 | 6-99 | 21.1 | 4.7 | 11-33 | 1.2 | 1.4 | 0-7 | 0.2 | 0.6 | 0-3 | 1.7 | 2.8 | 0-17 | 2.1 | 2.8 | 0-12 | 8.4 | 4.0 | 2-19 |
| Total | 231 | 147.3 | 11.9 | 114-183 | 58.2 | 26.5 | 1-99 | 20.5 | 6.2 | 4-39 | 0.9 | 1.2 | 0-7 | 1.7 | 4.2 | 0-20 | 8.7 | 8.2 | 0-35 | 1.4 | 2.6 | 0-17 | 10.0 | 5.0 | 2-27 |
| 1980-81 | | | | | | | | | | | | | | | | | | | | | | | | | |
| School A | 75 | 166.8 | 14.6 | 128-203 | 72.1 | 23.9 | 6-99 | 18.6 | 6.0 | 7-34 | 0.8 | 1.3 | 0-8 | 1.5 | 4.0 | 0-20 | 18.2 | 7.9 | 1-33 | 1.0 | 1.5 | 0-6 | 7.7 | 3.2 | 2-15 |
| School B | 52 | 158.0 | 16.0 | 124-197 | 56.7 | 28.5 | 4-99 | 19.3 | 4.4 | 10-28 | 0.5 | 1.0 | 0-4 | 2.2 | 3.5 | 0-10 | 9.8 | 3.8 | 0-18 | 0.5 | 1.2 | 0-5 | 4.1 | 1.8 | 1-9 |
| School C | 45 | 163.2 | 14.5 | 129-203 | 65.9 | 25.0 | 6-99 | 20.0 | 6.3 | 9-36 | 1.1 | 1.1 | 0-5 | 1.6 | 2.8 | 0-10 | 3.4 | 3.2 | 0-9 | 0.3 | 0.8 | 0-4 | 5.5 | 2.2 | 1-9 |
| School D | 69 | 161.1 | 16.1 | 124-203 | 60.4 | 27.9 | 4-99 | 16.9 | 7.8 | 3-35 | 0.5 | 1.0 | 0-6 | 0 | 0 | 0 | 8.1 | 4.7 | 0-16 | 0.8 | 1.5 | 0-7 | 5.4 | 2.6 | 1-13 |
| Total | 241 | 162.3 | 15.6 | 124-203 | 64.3 | 26.8 | 4-99 | 18.5 | 6.4 | 3-36 | 0.7 | 1.1 | 0-8 | 1.2 | 3.1 | 0-20 | 10.7 | 7.8 | 0-33 | 0.7 | 1.4 | 0-7 | 5.9 | 2.9 | 1-15 |
| 1981-82 | | | | | | | | | | | | | | | | | | | | | | | | | |
| School A | 60 | 174.6 | 16.1 | 133-208 | 65.5 | 25.7 | 4-99 | 18.7 | 6.9 | 4-29 | 0.4 | 0.7 | 0-3 | 0.7 | 1.6 | 0-6 | 13.3 | 5.0 | 0-26 | 0.4 | 0.9 | 0-6 | 4.0 | 2.2 | 0-8 |
| School B | 49 | 167.0 | 18.7 | 131-206 | 53.1 | 30.6 | 2-99 | 17.0 | 4.6 | 7-25 | 0.4 | 0.7 | 0-3 | 2.3 | 4.3 | 0-19 | 5.6 | 3.7 | 0-14 | 0.0 | 0.1 | 0-1 | 4.7 | 2.3 | 0-11 |
| School C | 44 | 173.7 | 16.3 | 142-220 | 63.7 | 25.3 | 12-99 | 14.4 | 10.7 | 0-34 | 0.6 | 1.0 | 0-4 | 0.3 | 0.5 | 0-2 | 11.6 | 8.4 | 0-28 | 1.5 | 2.6 | 0-9 | 5.3 | 2.0 | 2-10 |
| School D | 57 | 171.8 | 15.3 | 145-206 | 61.1 | 24.9 | 16-99 | 11.4 | 6.3 | 2-30 | 0.4 | 0.6 | 0-3 | 1.0 | 2.6 | 0-10 | 9.7 | 6.0 | 0-24 | 0.0 | 0.2 | 0-1 | 4.2 | 2.3 | 0-11 |
| Total | 210 | 171.9 | 16.7 | 131-220 | 61.0 | 26.9 | 2-99 | 15.4 | 7.8 | 0-34 | 0.4 | 0.8 | 0-4 | 1.1 | 2.7 | 0-19 | 10.2 | 6.5 | 0-28 | 0.4 | 1.4 | 0-9 | 4.5 | 2.3 | 0-11 |

Time On-Task and Student Performance

It is reasonable to ask at this point: To what extent does the amount of time students are on-task account for variance in their academic performance? Multiple regression analysis was used to examine the relationship between reading and mathematics achievement test scores and the amount of time students spent on-task and in process activity in these subjects.

Tables 2.4A and 2.4B show the coefficients of determination (R^2) between reading achievement and mathematics achievement, and one, two, three, and all six variables reflecting time on-task in modes of instruction and process time in reading and in mathematics. The results are shown for each of the four schools and for each of the three years in which students were observed. The correlation from which the coefficients of determination shown in Tables 2.4A and 2.4B were derived were statistically significant at the .05 level of confidence. With regard to reading achievement (Table 2.4A) for students in grade three, the relationship between time spent on-task and in process activities in reading and student achievement in reading varied quite widely among the four schools with R^2 ranging from .13 in School 4 to .54 in School 2. Considerable variability also existed with regard to the modes of instruction most closely associated with reading achievement in the four schools. For example, independent study and working with other students were the most important variables in School 1 but time spent in large-group instruction and process time were the most important variables in School 3. For the entire sample, independent study and working with other students were the variables most closely associated with reading achievement. In fact, time on-task in independent study was nearly as useful as all six variables in accounting for variance in student reading achievement for the total sample for third graders.

Similar variability in relationships also occurred at grade 4. R^2 's range from .15 in School 3 to .54 in School 1 with R^2 for the total sample of .20. Time on-task in independent study again appeared to be associated with reading achievement scores, either alone or in combination with other variables. Time on-task in small-group instruction or in large-group instruction also exhibited relationships to student achievement. Although no single variable was a particularly good predictor of reading achievement for the entire sample, three variables (time on-task in independent study, large-group instruction, and process behavior) were just as useful as all six variables in accounting for variance in reading achievement for the total sample.

The strongest association between time on-task and reading achievement appeared at grade five with a R^2 of .27. For the individual schools, two variables (time on-task in independent study and in small-group instruction) produced an R^2 of .72 for School 1. The R^2 values for Schools 2, 3, and 4 ranged from .37 to .45. Time on-task in independent study was the best single predictor of reading achievement for the total sample but the prediction was considerably improved when three variables (time on-task in independent study, one-to-one instruction, and working with other students) were entered. Time

Table 2.4A

Relationships of Amount of Time on-Task and Process Time in Reading to Student Achievement in Reading for the Four Schools and Total Sample*

| Regression Model | School 1 | | School 2 | | School 3 | | School 4 | | All Schools | |
|------------------|----------|----------------|----------|----------------|----------|----------------|----------|----------------|-------------|----------------|
| | Var. | R ² | Var. | R ² |
| Grade 3 | N = 72 | | N = 52 | | N = 38 | | N = 69 | | N = 231 | |
| One variable | E | .15 | A | .38 | D | .24 | F | .04 | A | .16 |
| Two variables | A,E | .27 | A,F | .46 | D,F | .32 | E,F | .09 | A,E | .16 |
| Three variables | A,C,E | .33 | B,C,F | .50 | B,D,F | .35 | A,E,F | .13 | A,E,B | .17 |
| All variables | | .36 | | .54 | | .37 | | .13 | | .17 |
| Grade 4 | N = 75 | | N = 52 | | N = 45 | | N = 69 | | N = 241 | |
| One variable | C | .34 | A | .35 | E | .08 | D | .23 | D | .07 |
| Two variables | D,E | .41 | A,B | .39 | A,E | .11 | A,D | .32 | A,D | .15 |
| Three variables | A,D,E | .49 | A,B,F | .41 | A,B,E | .12 | A,C,D | .33 | A,D,F | .20 |
| All variables | | .54 | | .46 | | .15 | | .36 | | .20 |
| Grade 5 | N = 57 | | N = 49 | | N = 44 | | N = 55 | | N = 205 | |
| One variable | C | .68 | A | .20 | E | .22 | A | .34 | A | .13 |
| Two variables | A,C | .72 | A,F | .28 | A,E | .35 | A,B | .41 | A,E | .19 |
| Three variables | A,C,D | .72 | A,C,F | .33 | A,B,E | .36 | A,B,E | .44 | A,B,E | .24 |
| All variables | | .72 | | .37 | | .40 | | .45 | | .27 |

Table 2.4B

Relationships of Amount of Time on-Task and Process Time in Mathematics to Student Achievement in Mathematics for the Four Schools and Total Sample*

| Regression Model | School 1 | | School 2 | | School 3 | | School 4 | | All Schools | |
|------------------|----------|----------------|----------|----------------|----------|----------------|----------|----------------|-------------|----------------|
| | Var. | R ² | Var. | R ² |
| Grade 3 | N = 72 | | N = 52 | | N = 38 | | N = 69 | | N = 231 | |
| One variable | F | .20 | D | .34 | A | .33 | D | .14 | C | .12 |
| Two variables | C,F | .29 | B,D | .38 | A,D | .42 | D,F | .17 | C,F | .18 |
| Three variables | C,E,F | .34 | B,D,F | .40 | A,B,D | .45 | C,D,F | .20 | A,C,F | .21 |
| All variables | | .38 | | .42 | | .50 | | .27 | | .23 |
| Grade 4 | N = 75 | | N = 52 | | N = 45 | | N = 69 | | N = 241 | |
| One variable | D | .47 | C | .33 | B | .04 | B | .09 | D | .11 |
| Two variables | B,D | .50 | C,F | .39 | B,F | .06 | B,F | .13 | C,D | .18 |
| Three variables | B,D,E | .52 | C,D,F | .44 | A,B,F | .09 | B,D,F | .14 | B,C,D | .20 |
| All variables | | .56 | | .45 | | .13 | | .15 | | .21 |
| Grade 5 | N = 60 | | N = 49 | | N = 44 | | N = 57 | | N = 210 | |
| One variable | F | .34 | D | .22 | D | .18 | B | .30 | D | .10 |
| Two variables | D,F | .54 | A,D | .29 | D,F | .25 | B,C | .33 | D,F | .13 |
| Three variables | C,D,F | .60 | A,B,D | .33 | C,D,F | .29 | A,B,F | .35 | A,C,D | .16 |
| All variables | | .63 | | .34 | | .32 | | .42 | | .18 |

Variables: A = Independent Study
 B = One-to-One
 C = Small Group
 D = Large Group
 E = With Other Students
 F = Process

*All correlations statistically significant at .05 level of confidence.

on-task in independent study was associated consistently with reading achievement in each of the four schools.

The amount of variance in reading achievement accounted for by these variables representing time on-task in five instructional modes and in process activity increased consistently from third to fourth to fifth grade for the total sample. The six variables accounted for about 17% of the variance in reading achievement in grade three, 20% of the variance in grade four, and 27% of the variance in grade five. However, patterns of association between these six variables and reading achievement, and the relationship between time on-task and reading achievement, were unique for each of the four schools. Furthermore, with the exception of School 2, where time spent on independent study appeared consistently for all three grades, the relationships between modes of instruction and student achievement varied from year to year.

In contrast, the relationships between the six independent variables and mathematics achievement (shown in Table 2.4B) declined between third and fifth grade. For the total sample, the six variables accounted for about 23% of the variance in mathematics achievement at the third grade, about 21% at fourth grade, and about 18% at fifth grade. The pattern of relationships within the individual schools, however, varied rather widely. The R^2 for the individual schools ranged from .27 to .50 at the third-grade level; from .13 to .56 at the fourth-grade level and from .32 to .63 at the fifth-grade level. No consistent pattern of relationships between time on-task in the five instructional modes and mathematics achievement was evident either within these four schools from grade to grade or among the four schools. For the entire sample, time on-task in either small-group or large-group instruction appeared with some consistency for each of the three grade levels, but these two variables did not appear consistently in the analyses for the individual schools. For the entire sample, time on-task in small group instruction was the best single predictor of mathematics achievement in grade three and grade four, and time spent on-task in large-group instruction was the best single predictor in grade five. In general, three variables were nearly as efficient as all six variables in accounting for variance in mathematics achievement.

The most useful predictors of reading achievement for this sample of students were time on-task in independent study and in large-group instruction; for mathematics achievement, the most useful predictors were time on-task in small-group instruction and in large-group instruction. Although all correlations upon which the coefficients of determination reported in Tables 2.4A and 2.4B were derived were statistically significant at the .05 level, it is evident that many factors other than time on-task were involved in accounting for variance in the academic achievement of this sample of students.

The way the time of an individual student is distributed among various instructional modes is probably a better descriptor of the student than it is a predictor of the student's academic achievement. For example, the most able students are likely to spend more time in independent study simply because they complete their assignments more

rapidly than other students. They also may be more likely to work with other students in a tutorial capacity where this practice is encouraged. Less able students, on the other hand, are more likely to be involved in one-to-one or small-group instruction simply because they are identified by the teacher as needing additional, more intensive, help.

The failure to identify a consistent pattern of relationships between time on-task and achievement in reading and mathematics in the analyses at the individual school level may reflect school effects, but it is more likely to reflect the preferred instructional procedures and classroom management skills of individual teachers. It should be noted that only two or three teachers were involved in teaching reading in any one school each year. Thus, while the relationships revealed in these analyses reflect individual student behaviors, they also reflect the patterns of instructional practice preferred by individual teachers. The choice among alternative modes of instruction generally will be made in terms of individual teacher preferences as well as their professional judgments with regard to the most effective mode of instruction for particular students. The number of students in a given class, the availability of teacher aides, and the use of instructional teams also are factors which influence the choice of an instructional mode within a given school or classroom.

The relationships between time on-task in five core academic subjects (reading, mathematics, language arts, social studies, and science) and student achievement in reading and mathematics also were examined to determine whether time on-task in all academic subjects was more useful in accounting for variance in student achievement in reading and mathematics than was time on-task in these specific subjects. The results of these analyses are shown in Tables 2.5A and 2.5B. In general, time on-task in reading was more useful in accounting for variance in reading achievement than was time on-task in all five academic subjects. It should be noted that the samples are not identical because the number of students with complete observations in all five subjects was smaller than the number of students with complete observations in reading or mathematics alone. No consistent pattern of relationships between time on-task and reading achievement was found for either the total sample over the three-year period, or for individual schools. Time on-task in independent study and time on-task in small-group instruction were the best single predictors of student achievement in reading. However, the amount of variance accounted for by the two variables differed widely from school to school.

The pattern of relationships between time on-task in the five academic subjects and mathematics achievement was similar to that found for reading achievement. Time on-task in all subjects was less useful than time on-task in the specific subjects of reading and mathematics in third grade, was slightly more useful in fourth grade, and slightly less useful in fifth grade. Time on-task in independent study appeared more frequently as a useful predictor in the data for all five subjects than it did for reading or mathematics alone. Again, this may reflect student characteristics rather than a direct relationship between time on-task in independent study and student achievement, i.e., students engaged in independent study may simply be more academically talented and thus score higher on an achievement test.

Table 2.5A

Relationships of Time On-Task and Process Time in Five Subjects (Reading, Mathematics, Language Arts, Science and Social Studies) to Student Achievement in Reading*

| Regression Model | School 1 | | School 2 | | School 3 | | School 4 | | All Schools | |
|------------------|----------|----------------|----------|----------------|----------|----------------|----------|----------------|-------------|----------------|
| | Var. | R ² | Var. | R ² |
| Grade 3 | | N = 49 | | N = 31 | | N = 38 | | N = 68 | | N = 186 |
| One variable | A | .25 | B | .14 | A | .16 | D | .13 | A | .10 |
| Two variables | A,E | .35 | B,F | .20 | A,D | .19 | D,E | .22 | A,B | .13 |
| Three variables | A,E,F | .37 | B,E,F | .22 | A,D,E | .21 | A,D,E | .27 | A,B,C | .13 |
| All variables | | .38 | | .23 | | .22 | | .29 | | .14 |
| Grade 4 | | N = 73 | | N = 52 | | N = 44 | | N = 53 | | N = 222 |
| One variable | C | .38 | A | .24 | C | .05 | A | .19 | C | .09 |
| Two variables | D,E | .46 | A,B | .29 | A,C | .11 | A,D | .31 | A,D | .20 |
| Three variables | C,D,E | .52 | A,B,C | .30 | A,C,F | .12 | A,D,E | .32 | A,D,E | .23 |
| All variables | | .54 | | .31 | | .13 | | .32 | | .24 |
| Grade 5 | | N = 57 | | N = 31 | | N = 44 | | N = 55 | | N = 187 |
| One variable | C | .64 | D | .33 | C | .25 | A | .27 | F | .03 |
| Two variables | C,F | .73 | D,E | .48 | C,E | .38 | A,B | .28 | C,F | .09 |
| Three variables | B,C,F | .73 | A,D,E | .51 | B,C,E | .38 | A,B,C | .29 | C,E,F | .11 |
| All variables | | .73 | | .53 | | .40 | | .29 | | .13 |

Table 2.5B

Relationships of Time On-Task and Process Time in Five Subjects (Reading, Mathematics, Language Arts, Science and Social Studies) to Student Achievement in Mathematics*

| Regression Model | School 1 | | School 2 | | School 3 | | School 4 | | All Schools | |
|------------------|----------|----------------|----------|----------------|----------|----------------|----------|----------------|-------------|----------------|
| | Var. | R ² | Var. | R ² |
| Grade 3 | | N = 49 | | N = 31 | | N = 38 | | N = 68 | | N = 186 |
| One variable | F | .21 | C | .13 | A | .12 | A | .15 | A | .07 |
| Two variables | E,F | .27 | B,C | .21 | A,D | .22 | A,D | .24 | A,B | .12 |
| Three variables | C,E,F | .31 | B,C,D | .22 | A,D,E | .25 | A,D,E | .28 | A,B,C | .13 |
| All variables | | .39 | | .23 | | .25 | | .30 | | .13 |
| Grade 4 | | N = 73 | | N = 52 | | N = 44 | | N = 53 | | N = 222 |
| One variable | B | .33 | C | .16 | C | .06 | D | .19 | C | .12 |
| Two variables | D,E | .44 | A,D | .21 | B,C | .08 | A,D | .29 | A,D | .19 |
| Three variables | B,D,E | .50 | A,D,F | .21 | B,C,F | .09 | A,D,E | .31 | A,D,E | .22 |
| All variables | | .52 | | .23 | | .10 | | .33 | | .25 |
| Grade 5 | | N = 57 | | N = 31 | | N = 44 | | N = 55 | | N = 187 |
| One variable | C | .42 | D | .33 | C | .17 | A | .24 | A | .05 |
| Two variables | C,F | .53 | A,D | .39 | C,F | .21 | A,D | .27 | A,F | .10 |
| Three variables | C,E,F | .54 | A,B,D | .46 | B,C,F | .23 | A,C,D | .32 | A,E,F | .12 |
| All variables | | .56 | | .50 | | .26 | | .35 | | .14 |

Variables: A = Independent Study
 B = One-to-One
 C = Small Group
 D = Large Group
 E = With Other Students
 F = Process

*All correlations statistically significant at .05 level of confidence.

When students in the bottom quartile, the middle half, and the top quartile in reading and mathematics achievement scores were analyzed separately using only the data for their on-task time in reading and in mathematics, it was found that time on-task was a more useful predictor of reading achievement scores for students in the lowest quartile than for those in the middle half or the highest quartile, particularly in reading (see Table 2.6). One analysis was conducted using national norms to establish the quartiles; a second analysis was conducted in which quartiles were based on the sample distribution. For example, using national norms, only 27 students in the 1979-80 sample were below the 26th percentile in reading achievement and 87 were above the 74th percentile. Using the sample distribution, students below the 46th percentile were in the lowest quartile in 1979-80 and those above the 84th percentile were in the highest quartile.

The six time usage categories (the five instructional modes and process time) accounted for 56% of the variance in reading achievement scores for third graders in the lowest quartile on national norms and for 45% of the variance in reading achievement for students in the lowest quartile based on the sample distribution. For mathematics achievement, the comparable numbers were 30% and 19%, respectively. For students in the highest quartile on national norms, the six variables accounted for 14% of the variance in reading achievement. For students in the highest quartile based on the sample distribution, the variables accounted for 15% of the variance in reading achievement. For mathematics achievement, however, the comparable numbers were 7% and 9%, respectively. At the fourth-grade level, the same general pattern existed, although the amount of variance in achievement test scores accounted for in the lowest quartile of students was considerably lower than at the third-grade level. At the fifth-grade level, the six independent variables were much better predictors for lower quartile students than for students in the middle half or highest quartile in reading achievement. For mathematics achievement, however, the amount of variance accounted for was quite similar in all three categories.

The relationships between student achievement in reading and mathematics and on-task time in these two subjects also were examined for students in the high and low quartiles of the total sample. The results are shown in Table 2.7. For students in the low quartile in reading achievement, time on-task in small-group instruction was the variable associated most strongly with reading achievement in grades four and five. Process time was the best single predictor of reading achievement for low quartile students in grade three and the second most useful predictor in grades four and five. Process time accounted for 33% of the variance in reading achievement for students in the lowest quartile in grade three and, in combination with small-group instruction, accounted for 24% of the variance in grade four and 22% of the variance in grade five. These six variables accounted for relatively little of the variance in reading achievement scores for students in the highest quartile in reading and none of the variables was consistently associated with reading achievement scores for students in the high quartile.

Table 2.6

Relationships of Time On-Task and Process Time in Reading
and Mathematics to Student Achievement in Reading
and Mathematics in Quartiles 1, 2-3, and 4*

| | Reading Achievement | | | | | | | | |
|---------------------|---------------------|----|----------------|-------------|----------------|------------------|----------------|--------|--|
| | Lowest Quartile | | | Middle Half | | Highest Quartile | | | |
| | <%ile | N | R ² | N | R ² | N | R ² | %ile > | |
| <u>1979-80</u> | | | | | | | | | |
| National norm | 26 | 27 | .56 | 114 | .08 | 87 | .14 | 74 | |
| Sample distribution | 46 | 53 | .45 | 123 | .07 | 55 | .15 | 84 | |
| <u>1980-81</u> | | | | | | | | | |
| National norm | 26 | 34 | .27 | 116 | .06 | 91 | .04 | 74 | |
| Sample distribution | 38 | 61 | .31 | 119 | .08 | 61 | .12 | 82 | |
| <u>1981-82</u> | | | | | | | | | |
| National norm | 26 | 16 | .73 | 108 | .16 | 82 | .16 | 74 | |
| Sample distribution | 48 | 49 | .31 | 106 | .13 | 50 | .10 | 86 | |

Mathematics Achievement

| | | | | | | | | | |
|---------------------|----|----|-----|-----|-----|-----|-----|----|--|
| <u>1979-80</u> | | | | | | | | | |
| National norm | 25 | 32 | .30 | 121 | .12 | 75 | .07 | 74 | |
| Sample distribution | 38 | 56 | .19 | 118 | .17 | 57 | .09 | 80 | |
| <u>1980-81</u> | | | | | | | | | |
| National norm | 25 | 26 | .18 | 114 | .12 | 100 | .04 | 74 | |
| Sample distribution | 46 | 63 | .12 | 118 | .14 | 60 | .08 | 88 | |
| <u>1981-82</u> | | | | | | | | | |
| National norm | 25 | 30 | .12 | 104 | .19 | 76 | .17 | 74 | |
| Sample distribution | 42 | 50 | .15 | 108 | .07 | 52 | .13 | 84 | |

*All correlations statistically significant at .05 level of confidence.

Table 2.7

Relationships of On-Task Time by Mode of Instruction and Process Time
in Reading and Mathematics to Student Achievement in Reading
and Mathematics in High and Low Quartiles*

| Regression Model | Reading Achievement | | | | Mathematics Achievement | | | |
|---------------------|---------------------|----------------|---------------|----------------|-------------------------|----------------|---------------|----------------|
| | Low Quartile | | High Quartile | | Low Quartile | | High Quartile | |
| | Var. | R ² | Var. | R ² | Var. | R ² | Var. | R ² |
| Grade 3 | N = 53 | | N = 55 | | N = 56 | | N = 57 | |
| One variable | F | .33 | D | .04 | F | .14 | E | .04 |
| Two variables | D,F | .41 | A,D | .10 | E,F | .17 | E,F | .07 |
| Three variables | A,D,F | .43 | A,D,E | .15 | A,C,F | .18 | C,E,F | .09 |
| All variables | | .45 | | .15 | | .19 | | .09 |
| Grade 4 | N = 61 | | N = 61 | | N = 63 | | N = 60 | |
| One variable | C | .13 | B | .06 | A | .04 | C | .04 |
| Two variables | C,F | .24 | B,C | .09 | A,B | .07 | C,F | . |
| Three variables | C,E,F | .28 | B,C,D | .11 | A,D,F | .10 | C,D,F | .07 |
| All variables | | .31 | | .12 | | .12 | | .08 |
| Grade 5 | N = 49 | | N = 50 | | N = 50 | | N = 52 | |
| One variable | C | .15 | F | .04 | B | .05 | D | .07 |
| Two variables | C,F | .22 | A,F | .05 | B,D | .08 | D,E | .09 |
| Three variables | C,E,F | .25 | A,E,F | .08 | B,D,E | .11 | D,E,F | .12 |
| All variables | | .31 | | .10 | | .15 | | .13 |

Variables: A = Independent Study
B = One-to-One
C = Small Group
D = Large Group
E = With Other Students
F = Process

*All correlations statistically significant at .05 level of confidence.

This set of variables accounted for relatively little of the variance in mathematics achievement for students in either the low or high quartile, and no consistent relationships were evident in either the low or the high quartile from year to year.

Discussion

One must be quite cautious in generalizing from the results obtained from these analyses. First, although the correlations were statistically significant, they may be of limited practical significance to teachers and administrators. That is, a great deal of the variance in student achievement was not accounted for by differences in time on-task, at least for the sample of elementary school students involved in this study. Furthermore, no consistent pattern of relationships between time on-task in various modes of instruction and student achievement in reading or in mathematics was evident. While time on-task is important and should not be ignored as a source of variance in student achievement, it clearly is not a panacea.

Second, it is quite possible that time on-task serves as a proxy for other variables, or that it exerts a mediating influence on student achievement. That is, time on-task may be a covariate of other variables (such as academic aptitude) known to be related to student achievement.

Third, when students are divided into quartiles, the sample size is reduced substantially and one or two "outliers" in the distribution can exert a powerful influence on resulting correlations. The data were examined carefully to identify anomalies, and obvious outliers were removed from the sample before the final analyses were performed. However, the results still can be influenced heavily by one or two students who are atypical in their patterns of time usage and achievement. The results of additional analyses in which time on-task was used in conjunction with other variables will be discussed in the following sections of this report.

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SECTION III

SCHOOL EXPENDITURES AND STUDENT ACHIEVEMENT*

The purpose of the research reported in this section was to examine the relationship between the allocation and use of human and physical resources in schools and classrooms, and the cognitive and affective outcomes of schooling manifested by students. This research addressed both equity and efficiency issues: (1) equity as reflected in the access of students to educational resources, and (2) efficiency as reflected in the productive use of resources available to principals and teachers. The issue that directly affected the research discussed in this section was equity as reflected in access of students to monetary resources. The relationship of most interest was that between the amount of monetary resources spent on individual students and academic achievement as expressed in their performance on standardized achievement tests.

Section I of this report contained an extensive discussion of the methodology used to select the school districts and descriptions of the sample of students, the procedures used to gather the data, and the statistical procedures used to analyze the data. That information will not be repeated in this section except when it has a direct affect on the variables and the relationships that were investigated in this phase of the study.

This phase of the study covered a three-year time period, 1979-80 through 1981-82. A cohort of children in four school districts was followed from the third through the fifth grade. Data were collected on a number of variables, including but not limited to home background, time on-task, school activities, affective behavior, teacher characteristics, school characteristics, academic achievement, and expenditures. Both cross-sectional and longitudinal analyses were completed on the relationship and interaction of these variables.

As noted earlier, the relationship of primary interest in this phase of the study was that between expenditure per pupil and academic achievement. Educators for decades have been preoccupied by an interest in this relationship, which invariably has been analyzed in studies comparing resources and educational productivity. In this study, unlike most studies, the monetary resources were gathered and attributed to specific students, not to buildings and not to classrooms. The actual cost of teaching a student was derived, including all instructional and instructional-related costs.

Other relationships of interest in this phase of the study included the relationship between expenditures per pupil and student time on-task, and the relationship between expenditure per pupil and student affective behavior. The relationships between expenditures for the

* This section was authored by Lloyd E. Frohreich, who directed the analysis of the data for this phase of the study.

sample that included all students, expenditures for the sample that excluded special students, and the dependent variables of time on-task and student affective behavior also were investigated in each case. Most of these relationships were examined for each year, as well as on a longitudinal basis across all three years. Because of the longitudinal nature of the study, all expenditures were adjusted through an implicit price deflator which used the general price index and January, 1983, as the base month and year.

Education finance research has been concerned with the relationship of input and output variables for over two decades. Researchers have been confronted with a variety of questions as they examined these relationships. Do differences in quality and quantity of resources lead consistently to differences in educational outcomes? What specific impact do schools have on students? What school characteristics and organizational configurations influence student behavior? Are the resources being allocated and utilized in the most effective manner? How much control do administrators and teachers have over variables that have a positive effect on student growth? Answers to any or all of the above questions would remove much of the uncertainty regarding the function and value of investment in education.

Research in recent years has begun to answer a few of these questions. Unfortunately, educators have tended not to accept the answers because more questions have been raised than have been answered, and research has not consistently demonstrated the impact of education variables (at least those over which we have some control) on student outcomes. The concern in this section of the study was with the relationship between the expenditure variables and selected student outcomes. The discussion that follows will be restricted primarily to a review of the research on the relationship between expenditures and student outcomes.

Research on School Expenditures and Student Achievement

The "cost-quality studies," as they were called in the early part of this century (Mort, Reusser, and Polley, 1960), examined gross measures of educational expenditures and various measures of school outcomes. The studies by Mort and others provided some rather conclusive evidence that a strong relationship existed between expenditure per pupil and school performance. Indeed, if these studies were replicated today, similar results might be found.

Even though the earlier research failed to reveal much about how to manage the educational enterprise, it should not be discarded as invalid. There is reason to believe that many of the cost/quality relationships still exist today for large units of analysis. Unfortunately, researchers have found that as smaller, more discrete units of analysis have been used, with a focus at micro levels, the earlier findings on the cost/quality relationship have not been sustained. The early cost/quality research did not reveal which school inputs had the greatest impact on student learning or even which resources made a difference. For years, based on these early studies,

educators and legislators thought that simply increasing the educational budget would automatically increase educational productivity. More recent research has shown that, while a gross relationship between expenditures and outcomes may exist, it is not necessarily a cause-and-effect relationship.

Over the last two or three decades a variety of studies and variables have been used to examine the relationship between inputs and outputs. Because this research was interested in those school resources which could be measured by monetary value, either specifically or indirectly, only research that included monetary variables will be discussed. Mollenkopf and Melville (1956) surveyed a sample of approximately 9,500 ninth-grade students in 100 schools and 8,400 twelfth-grade students in 106 schools. They examined the relationship between 34 independent variables and student scores on seven different aptitude and achievement tests using stepwise multiple regression and controlling statistically for socioeconomic factors. They found a significant relationship between measures of student achievement and per-pupil instructional expenditures. In a study with similar design characteristics, Goodman (1959) analyzed a sample of 70,000 seventh- and eleventh-grade students from 102 school districts in New York State. Goodman also controlled for socioeconomic factors and found a significant relationship between achievement of seventh-grade students and per-pupil instructional expenditures.

Thomas (1962) utilized Project Talent data and 1960 census data to examine the impact of a large number of home, school and community variables on student achievement. Thomas' sample consisted of tenth- and twelfth-grade students from 206 high schools scattered among 46 states. He used stepwise multiple regression techniques and found statistically significant relationships between student achievement and beginning teacher salaries. Benson (1965) conducted a study of California's public schools and found that teacher salaries and per-pupil instructional expenditures were significantly related to student achievement as reflected in standardized reading and mathematics test scores.

Kiesling (1967) re-examined data collected earlier in the New York QMP study. Kiesling's data, as were the data collected in all these early studies, were aggregated by school district rather than by individual school, classroom or student. Kiesling found a strong relationship between per-pupil expenditure and student performance in urban school districts but a weak relationship in rural districts.

The Equality of Educational Opportunity (EEO) Study, known as the Coleman Report (1966), was the first large scale study to use disaggregated variables in the specification of an educational production function. Coleman obtained data from 645,000 students in 3,100 schools. The input measures consisted of 93 variables grouped into four major categories--home background, teacher, student body, and facility and curriculum measures. The dependent variables were scores on standardized achievement tests. The researchers found a strong relationship between the home background variables and student

achievement. So dominant were the socioeconomic status variables that all other variables showed only marginal effects on student performance when all major independent variables remained in the input mix.

Criticisms of Coleman's work (essentially on the basis of inappropriate statistical techniques) led to a re-analysis of the same data by other researchers. Hanushek (1968) found that teacher characteristics such as verbal ability and years of experience were significantly related to student achievement. Bowles (1970) used a subset of the EEO data and found other teacher characteristics that were important. Levin (1970) also used EEO data and found additional significant relationships between school resources, teacher variables, and student performance.

The Coleman research was followed by a series of studies in which various monetary variables such as instructional expenditure per pupil, beginning teacher salary, average or median teacher salary or some other expenditure variable was found to be related (or not related) to some measure of pupil performance. The findings were inconsistent and not particularly important, since the amount of variance in student performance variables explained was minimal.

Cohn (1968) studied 377 public high schools in Iowa and found higher teacher salaries were associated with higher gain scores on achievement tests for students between the ninth and twelfth grades. Raymond (1968) studied West Virginia students and found higher teacher salaries were related to higher grade point averages and higher ACT scores. Ribich (1968, p. 87) observed that the effect of increases in school expenditures was greatest at the lower end of the expenditure range and that as expenditures were increased there was a diminished effect on the increase in student performance for students in the lowest quintile of socioeconomic status.

Kiesling (1969) found most of the associations between achievement and per-pupil expenditures in urban New York districts to be negative, and that per-pupil expenditures did not have a significant effect in non-urban districts. In another study, Kiesling (1970) reported that the amount of school resources devoted to central administration and supervision was related most consistently to pupil achievement.

Many of the studies reported above used aggregated data and faced a variety of methodological problems which subsequent studies have attempted to overcome. The problem of being unable to experimentally control educational variables in a laboratory setting likely will never be overcome. Education researchers simply will not be allowed to subject students and teachers to different experimental treatments based on some theory that is likely to provide one group with less learning or productivity than another group. The absence of a well-developed theory of learning also has hampered production function research.

The lack of disaggregated data also has hampered research efforts. Measures of central tendency such as means, medians and modes do not tell researchers much about the relationships among variables. Measures

of central tendency may reveal a relationship exists, but they mask the explanatory power that teachers and administrators are seeking. Education researchers long have decried the lack of a national education data bank which could be accessed by researchers. It is reasoned that such a data bank would save the time and money of disparate research efforts which, when added together, would exceed the cost of one major national effort.

Recent efforts (post 1974) have overcome some of the methodological problems that plagued earlier research efforts. Summers and Wolfe (1975) gathered data on individual pupils in the Philadelphia school system. They studied school and teacher effects on students of varying socioeconomic status, class sizes and performance levels, but they did not study the effects of monetary resources on student performance. Murnane (1975) conducted a similar study of inner-city children in Connecticut. He found, as did Summers and Wolfe, that various classroom environments and conditions affect children differently, depending on whether they are white or black, poor or rich, or low or high achievers. Many school resources appear to affect different types of students in different ways. For example, low-achieving students appear to learn more from less experienced teachers, while just the opposite is true for high-achieving students. It is clear that recent research endeavors that have focused on the individual student have been quite productive in terms of gaining understanding of the complex interactions that take place in the classroom. The value of using the individual child as the unit of analysis, of using a student's progress as a measure of school effectiveness (instead of a student's achievement level), and of identifying the resources a child actually receives rather than the average resources in a school has been established.

Production function studies are based on the assumption that educational processes are similar to industrial processes. Analysts have drawn upon economic theory to guide their efforts in estimating the relationships between school resources and educational outcomes. As noted earlier, gross measures of central tendency fail to describe how resources are allocated among classrooms or among students within a classroom. The decisions of teachers, administrators, students and parents have an important effect on the production of education and the interaction of these effects is complex. Research into the economics of education to date has failed to account for the processes by which inputs are transformed into outcomes within classrooms.

Monk (1981) suggested it would be desirable to gain an understanding of how such economic phenomena as (1) substitution of inputs, (2) economies and diseconomies of scale, (3) jointness in the costs of resources as well as in the production of outcomes, and (4) the allocation of nonpurchased resources such as students' time affect the manner in which resources are combined within schools and classrooms for the purpose of producing learning outcomes. Hanushek (1981) suggested that the complexity of the education process is greater than can be accommodated in current analytical designs and that it is likely that there is no best practice that uniformly produces high achievement.

Without a detailed understanding of the entire education process, it may not be possible to understand why a particular technique works in one setting and not another.

Hanushek (1981) found that most studies of education finance focused upon the flow of money to particular institutions or particular types of individuals. Virtually no research has considered how expenditure flows influence the operation of the educational system and ultimately the nature and quality of educational outcomes. Educational finance research has provided knowledge about who pays for education and who receives educational services but little information about the benefits of those expenditures and their impact on the educational system and on educational outcomes. Again, recent studies have begun to consider how schools and individuals react to alternative financing schemes. Such information is needed to introduce or change policies that affect resource distribution systems. However, there is little evidence that available research has been used to alter existing policies.

A few studies have focused primarily at the micro level of analysis, e.g., the classroom or individual student rather than a school district or school building. Wendling and Cohen (1981) reported that average third-grade reading and mathematics scores in a sample of over 1,000 public elementary schools in New York State were related, at statistically reliable levels, to variations in the education resources available in schools. It is increasingly important to show whether and in what circumstances additional dollars can lead to improved outcomes. The independent variables included by Wendling and Cohen were operating expenditures and instructional expenditures measured in real terms and deflated by a cost of education index established for New York schools. The approved operating expenditures per pupil were associated positively with greater levels of reading achievement. These researchers found that the average achievement in rural schools was slightly greater, yet the resources available tended to be less. This prompted the suggestion that more research needs to be conducted on rural schools.

Butler and Monk (1985) looked at the role of scale and efficiency in New York schools. They suggested there are reasons to believe that rurality contributes to the efficiency of school district operations because rural communities are more homogeneous than urban communities. (Rural districts were defined as enrolling fewer than 2,500 pupils.) Rural communities are more stable than urban communities, and stability can contribute to school effectiveness. There is a sense of belonging which manifests itself in greater participation in extracurricular activities and perhaps in scholastic achievement. They found that rural communities tend to spend less on education than do other communities, that teacher salaries tend to be lower in rural districts, and that smaller school districts devote a greater percentage of their budgets to teacher salaries than do large districts. They also found that smaller school districts were able to provide school services at lower cost as enrollments increased.

Mann and Inman (1984) studied instructionally effective schools and found that, while money may be helpful, effective schools do not necessarily cost more to operate. They suggested that, among other conditions, instructionally effective schools emphasized instructional leadership, set realistic achievement goals for children, set high expectations for teachers and staff and offered a wide variety of instructional materials in the classroom.

Coleman and LaRocque (1984) studied economies of scale in schools in British Columbia. They found the partial correlations between school district size and district gross operating costs were low and not significant. Teacher salaries and the pupil-teacher ratio explained 92.5% of the variation in operating costs. They concluded that the relationship between school district size and per-pupil operating costs is spurious, and that attempts to control operating costs should focus on teacher salaries and a combination of average building size and pupil-teacher ratio.

Rutter (1981) cited many studies that suggested additional school expenditures are not likely to increase pupil achievement. This does not imply that schooling has no effect, however, since studies in other countries have shown that the absence of schooling has deleterious effects on intellectual and skill development. Those school effects that were found to matter consistently were the attitudes of the staff and the overall school climate or atmosphere. Recent large-scale studies have tended to show that variations between schools and the general resources available to them did not account for differences in pupil outcome. That is, variables such as expenditures per pupil, number of library books, teacher-pupil ratio, and teacher qualifications have not consistently shown a strong relationship with pupils' levels of attainment. Neither the level of financial resources nor the quality of buildings were found to constitute features which were essential for effective schooling. It must be noted that these conclusions were reached over the range of buildings and districts studied, a range that has tended to narrow in recent years in many states. The range also has reached a level that may be considered by many educators and researchers as adequate to do the job of educating children.

Rutter (1981) concluded it would be foolish to assume that resources are of no importance. Clearly a basic minimum is essential. Nor does research demonstrate that large-scale cuts in the educational budget would have no effect. Budget cuts can damage staff and student morale, curtail programs, or provide for inadequate maintenance--all of which could combine to curtail school effectiveness. Nevertheless, within the range of resources typically available in American schools, the precise level of expenditure seems to be of limited importance to pupil outcomes. One may conclude that an increase in resources is not likely to be an effective means of improving schools, but, of course, the ways in which resources are employed may be very important.

Thomas (1977) was concerned with the allocation of resources within educational systems and particularly the relationship between student time and student achievement. The difference between his approach and

many previous approaches was that Thomas emphasized the importance of collecting data which was disaggregated to the level of the individual student and parent. Micro-level decisions made by teachers, parents and students have an important effect on both efficiency and equality. Katzmann (1971) found no evidence that simply spending more money will improve performance and that spending money to decrease class size is apparently not effective within the range of 16 to 35 students. Many studies with conflicting conclusions lead one to believe that the cause-and-effect relationships in education may be more complex than most researchers had anticipated. Thomas was among the first to recognize that schooling is a multilevel process that involves students, classrooms, buildings, districts and higher levels of government.

Rossmiller's (1978) study of 28 IGE schools included an analysis of the relationship between expenditures and achievement. The six expenditure variables accounted for only 17% of the variance in reading achievement, while expenditure per pupil for salary alone accounted for 11%. About 17% of the variance in mathematics achievement was accounted for by the six expenditure variables. The six expenditure variables accounted for 29% of the variance in the social confidence of students, with instructional salaries accounting for nearly three-fifths of the 29%. Rossmiller cautioned that these findings did not warrant generalization because of the small sample size and shortcomings of the data base.

Summary

With a few notable exceptions, education researchers have been relatively unconcerned with the application of economic principles to the internal operations of schools and classrooms. The 1980s have witnessed a series of research efforts which viewed student time as a resource and compared it with student productivity as measured by standardized tests. Researchers today are avoiding many of the pitfalls of early research on educational productivity and increasingly are focusing on the micro relationships within the classroom on a student-specific basis.

Hanushek (1981) examined 130 studies that were directed primarily at identifying characteristics of schools and teachers that relate to school quality as measured by student performance. The following table summarizes his findings:

| <u>Input Variable</u> | <u>Studies</u> | <u>Significance</u> | | <u>Not</u> |
|-----------------------|----------------|---------------------|-----------------|--------------------|
| | | <u>Positive</u> | <u>Negative</u> | <u>Significant</u> |
| Teacher Education | 101 | 6 | 4 | 87 |
| Pupil-Teacher Ratio | 109 | 13 | 9 | 90 |
| Teacher Experience | 104 | 30 | 6 | 68 |
| Expenditure/Pupil | 55 | 5 | 3 | 47 |

Most of these efforts were production-function type studies that used regression analysis and regression coefficients. Note that the variable of most interest to the present research was expenditure per pupil and also that there is no overriding evidence that any expenditure variable influences educational productivity or student performance in any consistent manner.

The teaching-learning environment is complex. It is difficult to specify all of the variables that affect learning, measure each variable accurately, and then explain how they rationally and logically relate to one another. The complexity of educational systems may surpass the ability of educational decisionmakers to gather, store and utilize the amounts of information required in order that inputs and technologies may be matched with the characteristics of individual learners (Thomas, 1977). It is likely that only those who are in the classroom and close to the learning process can manipulate relationships between inputs and outputs in such a way as to substantially affect educational productivity.

Methodology

The sample for this micro level analysis of individual students was drawn from four elementary schools. Section I provided a complete description of each school and the reasons why each was selected to participate in this study. A cohort of students in each school was tracked, and data were collected on each student in grade 3 in 1979-80, grade 4 in 1980-81 and grade 5 in 1981-82. The total distribution of students in each year according to regular and special status was as follows:

| | <u>1979-80</u> | <u>1980-81</u> | <u>1981-82</u> |
|------------------|----------------|----------------|----------------|
| Regular Students | 209 | 219 | 204 |
| Special Students | <u>34</u> | <u>30</u> | <u>13</u> |
| Total Students | 243 | 249 | 217 |

Participating schools were visited by the project team three times during each of the three years of the study and a variety of data were collected on each student.

Instruments and Data Collection

The four instruments used to collect data for the independent cost variables used in the study were described in Section I. They included:

1. The Instruction and Instruction-Related Expenditure Form;
2. The Full-Time Equivalent (FTE) data form for instruction personnel;
3. The Pupil Count data form for non-instructional personnel;
4. The Individual Student FTE Assignments and Costs Form.

Direct and indirect program costs for individual students were collected by means of these instruments. Direct costs included

expenditures for teachers or other persons working directly with students. Indirect costs included expenditures for building administrators, librarians and counselors, and were attributed to all students on a pro-rata basis. Indirect program costs per student were calculated by dividing total students served into administrator, guidance counselor, or librarian's total salary plus fringes. Direct program costs were calculated using three major components: (1) the standard school day, (2) the standard school year, and (3) the full-time equivalent number of students for each instructor.

The standard school year consisted of the total days of instruction provided each school year. The standard school day was calculated for each school from the regular teachers' classroom schedules. Actual time students spent in instruction per week was summed across the schedule. The total was divided by days per week students were taught to give the daily average time in instruction. This procedure was repeated for each teacher who instructed the students. The mean was then calculated across all regular teachers for the grade or unit of instruction by year at each school. The ranges of average standard days and instructional days per year for the four schools across three years were as follows:

| | <u>1979-80</u> | <u>1980-81</u> | <u>1981-82</u> |
|----------------------------------|----------------|----------------|----------------|
| Instructional Day/Year Range | 176-180 | 177-180 | 175-180 |
| Standard Day Range in Minutes | 256-310 | 289-303 | 291-304 |

These data show a rather consistent pattern in both the number of instructional days and in the number of minutes of instruction each day across all four schools. The 1979-80 school year had the greatest variation in minutes of instruction per day, but by the third year the variation was only 13 minutes a day.

In addition to calculation of the standard instructional day, the actual daily instructional time was determined for each individual student. When the actual instructional-day length exceeded the mean standard-day length, as in the case of some special service students, the standard day then was the actual instructional day for those students.

The standard school day and standard school year were necessary factors for calculation of the full-time equivalent (FTE) unit. The FTE unit was critical to the allocation of costs to each student and across all students in the sample. The FTE unit indicates the division of a student's time among and between various programs. FTE differs from membership or head count data because it allows for the distribution of both teacher and student time according to the actual percentage of time spent on a specified instructional unit (mathematics, reading, etc.).

The FTE data were calculated for all teachers instructing students who were included in the sample. The FTE count was divided into total

salary and fringe benefits for each employee to determine the cost for one FTE student. That figure was used in determining a program cost for each unit of instruction and a cost for each student taking that instructional unit (reading, math, etc.).

The teacher FTE count was calculated by dividing the number of minutes spent instructing a group of students by the number of standard minutes in each day, which gave the percentage of time spent with a given group of pupils. The product of that percentage and the number of pupils in the group gave the FTE count attributed to that group of students for a particular teacher. If a teacher did not instruct a group of students for the full standard school year, the number of days became a factor in the calculation. The percentage of days times the percentage of time, times the number of students provided the FTE count for a unit of instruction for a particular teacher.

Several problems were encountered in the attribution of FTE counts among units of instruction. One methodological question in the individual student analysis procedure had to do with the attribution of costs among FT students in a program. The question arose as to the value of a teacher's time with groups of students of varying size. Following are three illustrations of how costs might be allocated according to time and teacher load.

Teacher A = \$10,000 salary; equal cost/FTE/section; number of students is constant; time is constant.

| <u>Students Enrolled</u> | <u>Time</u> | <u>Percent Time</u> | <u>FTE</u> | <u>Cost/Section</u> | <u>Cost/FTE</u> |
|--------------------------|---------------|---------------------|-------------|---------------------|-----------------|
| 20 | 2 hrs. | 33% | 6.67 | \$ 3,333 | \$500 |
| 20 | 2 hrs. | 33 | 6.67 | 3,333 | 500 |
| <u>20</u> | <u>2 hrs.</u> | <u>33</u> | <u>6.67</u> | <u>3,333</u> | <u>500</u> |
| 60 | 6 hrs. | 100% | 20 | \$10,000 | |

Teacher B = \$10,000 salary; equal cost/FTE; variable number of students per section; time is constant.

| <u>Students Enrolled</u> | <u>Time</u> | <u>Percent Time</u> | <u>FTE</u> | <u>Cost/Section</u> | <u>Cost/FTE</u> |
|--------------------------|---------------|---------------------|------------|---------------------|-----------------|
| 10 | 2 hrs. | 33% | 3.3 | \$ 1,658.28 | \$502.51 |
| 20 | 2 hrs. | 33 | 6.7 | 3,366.82 | 502.51 |
| <u>30</u> | <u>2 hrs.</u> | <u>33</u> | <u>9.9</u> | <u>4,974.85</u> | <u>502.51</u> |
| 60 | 6 hrs. | 100% | 19.9 | \$10,000.00 | |

Teacher C = \$10,000 salary; equal cost/section; variable number of students per section; time is constant.

| <u>Students Enrolled</u> | <u>Time</u> | <u>Percent Time</u> | <u>FTE</u> | <u>Cost/Section</u> | <u>Cost/FTE</u> |
|--------------------------|---------------|---------------------|------------|---------------------|-----------------|
| 10 | 2 hrs. | 33% | 3.3 | \$ 3,333 | \$1010.10 |
| 20 | 2 hrs. | 33 | 6.7 | 3.333 | 497.51 |
| <u>30</u> | <u>2 hrs.</u> | <u>33</u> | <u>9.9</u> | <u>3,333</u> | <u>336.70</u> |
| 50 | 6 hrs. | 100% | 19.9 | \$10,000 | |

Teacher A might represent a normal case of equal class size and equal class time. Cost per FTE pupil is the same for students in teacher A's classes. Teacher B is paid the same and classes are the same length, but class size varies. The assumption with Teacher B (and the assumption used to determine cost/FTE pupil in this study) was that each student who has Teacher B has an equal share of his/her time regardless of the class size. Teacher C is in exactly the same situation as Teacher B except that the assumption here is that a student receives more attention (higher quality time) in smaller classes and is charged more for it on a cost/FTE basis. Students in the smallest class are charged almost three times as much for their two hours with Teacher C as students in the largest class.

Which method of attributing costs is the best or most appropriate? Researchers have tended to use the Teacher B approach and assume that all students have an equal share of a teacher regardless of class size. On the other hand, it is difficult to argue against the point that a student is getting higher quality time in a smaller class and should be charged accordingly. In this study, costs were allocated to pupils following the method used in case B. While it may be argued that case C is more rational, the data needed to use method C were not available. In any event, the FTE student was used as a basis for allocating costs to each student in the sample, and this procedure has been used in very few (if any) studies to date.

Variables Used in the Analyses

The data forms and procedures discussed earlier resulted in the generation of several independent cost variables whose impact on selected dependent variables was analyzed in this study. The independent variables used, their symbols, and their definitions are discussed below.

Total cost per student (KIDCOST): The instructional cost that was directly attributed to each student, plus the administrative cost and instruction-related cost that were prorated across all students in a school based on load. The administrative cost and the instruction related cost for each student in the sample would be the same for students within one school.

Instructional cost per student (COSTEACH): The direct instructional cost per student for all subjects, including art, music, physical education and any direct non academic special services such as guidance.

Instructional cost per student for math plus science (NUMBERFTE): The direct instructional cost per student for mathematics plus science only.

Instructional cost per student for reading plus language arts plus social studies (WORDFTE): The direct instructional cost per student for reading plus language arts plus social studies.

Instructional cost per student for math (MATHFTE): The direct instructional cost per student for mathematics only.

Instructional cost per student for reading (READFTE): The direct instructional cost per student for reading only.

The specific cost variables described above were used in analyses that compared their variation with those dependent variables thought to be related. For example, does the instructional cost per student for mathematics and science (NUMBERFTE) and the instructional cost per student for mathematics (MATHFTE) bear any relationship to or impact on achievement scores in mathematics or longitudinal gain scores in mathematics? The same question could be raised for WORDFTE and READFTE and their concomitant dependent variables, achievement scores in reading and longitudinal gain scores in reading.

The dependent variables of primary interest were the achievement scores of students in reading and mathematics. The following four achievement score variables were used in this study.

Reading achievement test score (READSS): The reading scaled score on the Stanford Achievement Test (SAT) as recorded for each student in the sample for each year of the study.

Math achievement test score (MATHSS): The mathematics scaled score on the Stanford Achievement Test (SAT) as recorded for each student in the sample for each year of the study.

Reading achievement test score gain (DIFFREAD): The gain or loss in the reading scaled score for each student from Spring 1980, (grade 3) to Spring, 1982 (grade 5).

Mathematics Achievement Test Score Gain (DIFFMATH): The gain or loss in the mathematics scaled score for each student from Spring, 1980 (grade 3) to Spring, 1982 (grade 5).

To determine if time on-task had any relationship to the expenditure variables, the following time on-task variables were included as dependent variables in this phase of the study. It should be noted that the primary relationship of interest was the relationship between cost and achievement. The analysis done on the relationship between cost and time on-task and the subsequent analyses on the relationship between cost and selected self-observation scale variables were ancillary to the primary analyses. The time on-task variables are discussed below and proceed in order from more inclusive to more specific.

Total time on-task for all subjects (TOTLTIME): Total time on-task for each student in reading, language arts, social studies, mathematics, and science. Time on-task is measured for all of these subjects across all modes of instruction: independent, large group, small group, one-to-one, and with another student.

Total time on-task in mathematics and science (NUMBERTOT): The total time on-task per student for the subjects of mathematics and science.

Total time on-task in reading, language arts and social studies (WORDTOT): The total time on-task per student for the subjects of reading, language arts, and social studies.

Total time on-task in mathematics (MATHTOT): The total time on-task per student for the subject of mathematics alone.

Total time on-task in reading (READTOT): The total time on-task per student for the subject of reading alone.

The time on-task data were collected at three times during the academic year, and the time on-task score (in minutes) assigned to each student was an average of the three observations. Any missing data on a variable for a student caused that student to be dropped from an analysis. No data for these analyses were substituted or interpolated.

The Self-Observation Scale (SOS) variables used in this portion of the study were as follows:

AKSEPTS: Self-acceptance T score on self-observation scales (SOS).

SEKURTS: Self-security T score on SOS.

MATURTS: Social maturity T score on SOS.

CONFITS: Social confidence T score on SOS.

SKULATS: School affiliation T score on SOS.

TCHRATS: Teacher affiliation T score on SOS.

PEERATS: Peer affiliation T score on SOS.

A few additional comments on the variables and the data base are necessary for the reader to understand the analyses that follow. The variables KIDCOST and COSTEACH include art, music, physical education and guidance costs in addition to the regular subject matter costs. The corresponding time on-task variable, TOTLTIME, does not include art, music, physical education or guidance. The parallel cost variable to TOTLTIME would be the sum of WORDFTE and NUMBRFTE.

The longitudinal analyses utilized the two change-score variables defined earlier--DIFFREAD and DIFFMATH. The independent variables against which they were regressed were the mean costs over three years and the mean time on-task scores over three years.

Cost data were collected over a three-year period: 1979-80, 1980-81, and 1981-82. So that cost increases due to inflation would not influence the data analyses, an implicit price deflator was used to adjust the cost variables to a consistent point in time--January, 1983. The general price index increases for the three years of the study were 10.3% for 1980, 7.2% for 1981, and 4.8% for 1982. The general price index (GPI) was used rather than the consumer price index because the GPI is a more conservative estimate of inflation and more reflective of the prices school districts must pay. The implicit price deflator was .777 for 1980, .880 for 1981, and .952 for 1982 when January, 1983 was the base month and year.

Analysis of the Data

This section will report on the results obtained from the analysis of the data that showed the relationships between independent and dependent variables. The first part of this section will report descriptive data and statistics for the four schools used in the study.

Table 3.1 shows the expenditure and membership data for each of the four schools across the three years of the study. The expenditure data include gross and operating expenditures collected from the annual school district financial reports filed after the close of the fiscal year. The data shown in Table 3.1 were not adjusted for inflation. The expenditures shown are actual and unadjusted. The total size of the school district budgets ranged from \$6.57 million in District 2 for 2,362 pupils to \$35.76 million in District 1 for 9,535 pupils in 1981-82. All four districts had declining enrollments during this time. The highest cost per pupil was in District 1, with a gross expenditure of \$3,731 per pupil in 1981-82. The lowest was District 2 at \$2,781 per pupil in 1981-82. These four districts represent a fairly typical cross section of middle-class districts in Wisconsin and are representative of the size categories of which they are a member.

TABLE 3.1
Expenditure and Membership Data for Each
School District: 1979-80 through 1981-82

| | VARIABLE | DISTRICT 1 | DISTRICT 2 | DISTRICT 3 | DISTRICT 4 |
|---------|---------------------|------------|------------|------------|------------|
| 1979-80 | Gross Expenditure | \$24.5m | \$6.61m | \$6.6m | \$11.99m* |
| | Resident Membership | 9,754 | 2,477 | 2,663 | 4,572 |
| | Gross Expend./Pupil | \$2,516 | \$2,668 | \$2,480 | \$ 2,620 |
| | Oper. Expenditure | \$20.65m | \$4.26m | \$5.35m | \$ 8.49m |
| | Oper. Expend./Pupil | \$2,115 | \$1,722 | \$2,011 | \$ 1,855 |
| 1980-81 | Gross Expenditure | \$33.44m | \$7.0m | \$7.0m | \$11.72m |
| | Resident Membership | 9,685 | 2,416 | 2,567 | 4,585 |
| | Gross Expend./Pupil | \$3,452 | \$2,898 | \$2,730 | \$ 2,556 |
| | Oper. Expenditure | \$23.06m | \$4.94m | \$5.0m | \$ 9.46m |
| | Oper. Expend./Pupil | \$2,381 | \$2,045 | \$2,322 | \$ 2,063 |
| 1981-82 | Gross Expenditure | \$35.76m | \$6.57m | \$7.7m | \$12.81m |
| | Resident Members | 9,585 | 2,362 | 2,505 | 4,556 |
| | Gross Expend./Pupil | \$3,731 | \$2,781 | \$3,075 | \$ 2,812 |
| | Oper. Expenditure | \$25.22m | \$5.47m | \$6.45m | \$10.73m |
| | Oper. Expend./Pupil | \$2,631 | \$2,316 | \$2,576 | \$ 2,356 |

* m = million

Tables 3.2, 3.3, and 3.4 show the descriptive statistics on the cost data that were used in the analyses that follow. Table 3.2 is for the 1979-80 school year and shows the per-pupil costs for all of the subject matter areas, plus administrative costs and related costs. The only instruction-related costs not included are for speech and hearing classes. The number of students, mean, standard deviation, range and median are given for the cost per FTE in each subject matter area. The same data are given for year two of the study in Table 3.3 and for year three in Table 3.4.

Although many observations could be made about these data, the following comments highlight some of the more interesting or important aspects. Costs per pupil for reading were highest, followed by mathematics, language units, social studies and science in the first year. In the third year, costs per pupil for reading remained highest, followed by language arts, mathematics, science, and social studies. Of interest is the fact that reading and mathematics costs as a share of all instructional costs declined over the three-year period, while the share that language arts, science and social studies comprised of instructional costs increased. The administrative costs and related costs did not vary much among schools. Although not apparent in Tables 3.2 through 3.4, there was little variation in instructional cost per FTE student within subjects when the special students were eliminated from the sample. This lack of variation undoubtedly contributed to the lack of discernible relationships with the dependent variables that will be presented and discussed later. There were large blocks of students with identical class schedules and with the same teachers all day. The inflation-adjusted, bottom-line cost data in these tables were used to represent the variable KIDCOST in subsequent analyses.

A final summary table (3.5) shows the FTE costs per student for all four school districts across the three years. The costs are shown for the total sample of students, for the total sample less speech and hearing classes, and for the total sample less special students. Table 3.5 illustrates the dramatic reduction in the range and variation in costs when special students were removed from the sample. In the third year, for example, the KIDCOST (bottom line) goes from a range of \$934 to \$4090 per pupil for the total sample to a range of \$934 to \$1385 per pupil for the total sample less special students and speech and hearing classes.

Cost and Self-Concept

The first relationship of interest was between cost and self-concept. Does cost have any discernible affect on the self-concept of students? The first step was to examine the correlations in each set of independent and dependent variables to determine whether further statistical tests were appropriate. In Table 3.6, the Pearson product-moment correlations are shown for the independent cost variables and for the dependent self-concept variables that were discussed earlier in this section and described in detail in Section I. Table 3.6 includes all students, while Table 3.7 includes all non-special students, i.e., the special students in the sample were removed from this set of data.

TABLE 3.2

YEAR 1 PER PUPIL COST OF INSTRUCTION BY SUBJECT

| Subject | School 1 | | | | | School 2 | | | | | School 3 | | | | | School 4 | | | | |
|---------------------|----------|-----------|------|----------|------|----------|-----------|------|----------|------|----------|-----------|------|----------|------|----------|-----------|------|----------|------|
| | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. |
| Reading | 74 | \$195 | 30 | 110-223 | 194 | 56 | \$187 | 39 | 86-215 | 187 | 43 | \$194 | 32 | 153-248 | 175 | 70 | \$314 | 41 | 251-375 | 326 |
| Language Arts | 74 | 90 | 11 | 37-94 | 92 | 56 | 156 | 25 | 75-172 | 161 | 43 | 132 | 9 | 105-141 | 134 | 70 | 96 | 9 | 75-112 | 98 |
| Mathematics | 74 | 181 | 28 | 105-209 | 182 | 56 | 120 | 9 | 112-129 | 112 | 43 | 137 | 18 | 121-170 | 124 | 70 | 203 | 22 | 151-231 | 195 |
| Science | 74 | 32 | 1 | 26-33 | 32 | 56 | 52 | 0 | 52-52 | 52 | 43 | 62 | 19 | 47-86 | 47 | 70 | 87 | 1 | 83-88 | 88 |
| Social Studies | 74 | 77 | 4 | 61-80 | 78 | 56 | 45 | 0 | 45-45 | 45 | 43 | 48 | 9 | 40-61 | 40 | 70 | 107 | 8 | 88-112 | 112 |
| Art | 74 | 47 | 3 | 36-50 | 47 | 56 | 25 | 0 | 25-25 | 25 | 43 | 32 | 1 | 31-32 | 32 | 70 | 32 | <1 | 30-32 | 32 |
| Music | 74 | 67 | 2 | 56-67 | 67 | 56 | 30 | 0 | 30-30 | 30 | 43 | 39 | 1 | 38-40 | 38 | 70 | 47 | 1 | 45-47 | 47 |
| Physical Educ. | 74 | 47 | 2 | 40-48 | 48 | 56 | 36 | 0 | 36-36 | 36 | 43 | 40 | 2 | 37-43 | 41 | 70 | 43 | 1 | 40-43 | 43 |
| Special Services | 13 | 1190 | 660 | 582-2250 | 1163 | 10 | 505 | 217 | 300-726 | 470 | 7 | 269 | 131 | 175-453 | 175 | 4 | 833 | 407 | 222-1036 | 1036 |
| Instructional Cost | 74 | 944 | 464 | 733-2734 | 764 | 56 | 740 | 167 | 637-1230 | 688 | 43 | 727 | 133 | 630-1130 | 679 | 70 | 977 | 191 | 821-1844 | 939 |
| Administrative Cost | 74 | 54 | | | | 56 | 58 | | | | 43 | 48 | | | | 70 | 61 | | | |
| Related Cost | 74 | 53 | | | | 56 | 89 | | | | 43 | 62 | | | | 70 | 78 | | | |
| Total | 74 | 1052 | 464 | 840-2842 | 872 | 56 | 887 | 167 | 783-1377 | 834 | 43 | 837 | 133 | 740-1240 | 789 | 70 | 1117 | 191 | 960-1983 | 1078 |

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TABLE 3.3

YEAR 2 PER PUPIL COST OF INSTRUCTION BY SUBJECT

| Subject | School 1 | | | | | School 2 | | | | | School 3 | | | | | School 4 | | | | |
|-------------------------------|----------|-----------|------|----------|------|----------|-----------|------|----------|------|----------|-----------|------|----------|------|----------|-----------|------|-----------|------|
| | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. |
| Reading | 78 | \$218 | 42 | 156-274 | 202 | 55 | \$179 | 34 | 92-215 | 161 | 46 | \$163 | 19 | 128-253 | 169 | 69 | \$303 | 37 | 261-384 | 305 |
| Language Arts | 78 | 172 | | 87-219 | 162 | 55 | 130 | 37 | 14-157 | 152 | 47 | 166 | 39 | 10-221 | 164 | 69 | 108 | 14 | 87-128 | 102 |
| Mathematics | 78 | 189 | 4 | 84-208 | 187 | 54 | 130 | 12 | 103-142 | 138 | 46 | 152 | 35 | 84-190 | 150 | 69 | 239 | 21 | 187-256 | 244 |
| Science | 78 | 50 | 0 | 50-50 | 50 | 55 | 79 | 0 | 79-79 | 79 | 47 | 25 | 7 | 18-32 | 18 | 69 | 117 | 12 | 93-128 | 122 |
| Social Studies | 78 | 108 | 20 | 89-135 | 100 | 55 | 61 | 0 | 61-61 | 61 | 47 | 115 | 32 | 83-148 | 84 | 69 | 117 | 12 | 93-128 | 122 |
| Art | 78 | 56 | 0 | 56-56 | 56 | 55 | 32 | 0 | 32-32 | 32 | 47 | 34 | <1 | 32-34 | 34 | 69 | 46 | 1 | 42-46 | 46 |
| Music | 78 | 76 | 0 | 76-76 | 76 | 55 | 38 | 0 | 38-38 | 38 | 47 | 42 | <1 | 39-42 | 42 | 69 | 46 | 1 | 42-46 | 46 |
| Physical Educ. | 78 | 61 | 11 | 50-76 | 56 | 55 | 47 | 0 | 47-47 | 47 | 47 | 45 | <1 | 42-45 | 45 | 69 | 41 | 1 | 38-41 | 41 |
| Special Services ^a | 11 | 712 | 537 | 365-1639 | 365 | 7 | 838 | 595 | 375-1959 | 5 | 9 | 356 | 276 | 219-1071 | 238 | 3 | 896 | 214 | 649-1020 | 1020 |
| Guidance | 0 | 0 | 0 | 0 | 0 | 55 | 16 | 2 | 14-18 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Instructional Cost | 78 | 1031 | 274 | 834-2388 | 965 | 55 | 815 | 290 | 652-2335 | 763 | 47 | 803 | 151 | 615-1362 | 793 | 69 | 1055 | 184 | 887-1991 | 1017 |
| Administrative Cost | 78 | 57 | | | | 55 | 64 | | | | 47 | 55 | | | | 69 | 58 | | | |
| Related Cost | 78 | 82 | | | | 55 | 50 | | | | 47 | 75 | | | | 69 | 82 | | | |
| Total | 78 | 1170 | 274 | 973-2527 | 1104 | 55 | 929 | 290 | 765-2479 | 877 | 47 | 933 | 151 | 745-1492 | 923 | 69 | 1195 | 184 | 1027-2131 | 1157 |

TABLE 3.4

YEAR 3 PER PUPIL COST OF INSTRUCTION BY SUBJECT

| Subject | School 1 | | | | | School 2 | | | | | School 3 | | | | | School 4 | | | | |
|---------------------|----------|-----------|------|-----------|------|----------|-----------|------|-----------|------|----------|-----------|------|----------|------|----------|-----------|------|-----------|------|
| | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. | n | \bar{x} | S.D. | Range | Med. |
| Reading | 58 | \$293 | 4 | 289-299 | 290 | 49 | \$162 | 15 | 110-174 | 158 | 44 | \$189 | 35 | 146-241 | 193 | 62 | \$142 | 28 | 111-178 | 131 |
| Language Arts | 61 | 200 | 47 | 36-247 | 191 | 50 | 207 | 31 | 65-226 | 212 | 44 | 196 | 25 | 159-243 | 184 | 62 | 134 | 16 | 114-221 | 139 |
| Mathematics | 61 | 216 | 41 | 73-266 | 219 | 50 | 172 | 9 | 151-181 | 169 | 44 | 182 | 61 | 119-270 | 141 | 62 | 149 | 26 | 125-199 | 131 |
| Science | 61 | 140 | 4 | 135-142 | 142 | 50 | 139 | 11 | 90-141 | 141 | 45 | 122 | 44 | 83-180 | 83 | 62 | 181 | 34 | 166-266 | 166 |
| Social Studies | 61 | 106 | 0 | 106-106 | 106 | 50 | 66 | 3 | 44-67 | 67 | 45 | 120 | 10 | 111-135 | 111 | 62 | 130 | 5 | 100-131 | 131 |
| Art | 61 | 44 | 0 | 44-44 | 44 | 50 | 43 | <1 | 42-43 | 43 | 45 | 37 | 1 | 35-37 | 36 | 62 | 49 | 1 | 39-49 | 49 |
| Music | 61 | 65 | 0 | 65-65 | 65 | 50 | 57 | <1 | 55-58 | 57 | 45 | 47 | 1 | 44-48 | 46 | 62 | 52 | 2 | 42-53 | 53 |
| Physical Educ. | 61 | 72 | 0 | 72-72 | 72 | 50 | 65 | <1 | 62-63 | 63 | 45 | 50 | 1 | 47-51 | 49 | 62 | 44 | 1 | 35-44 | 44 |
| Special Services | 3 | 3280 | 0 | 3280-3280 | 3280 | 4 | 1721 | 649 | 1388-2694 | 1401 | 4 | 553 | 841 | 80-1813 | 160 | 2 | 1489 | 333 | 1254-1725 | 1489 |
| Instructional Cost | 61 | 1281 | 581 | 1089-3809 | 1156 | 50 | 1044 | 428 | 901-3238 | 932 | 45 | 978 | 240 | 785-2230 | 860 | 62 | 929 | 279 | 818-2571 | 852 |
| Administrative Cost | 61 | 69 | | | | 50 | 83 | | | | 45 | 64 | | | | 62 | 69 | | | |
| Related Cost | 61 | 100 | | | | 50 | 49 | | | | 45 | 85 | | | | 62 | 91 | | | |
| TOTAL | 61 | 1451 | 581 | 1258-3979 | 1326 | 50 | 1175 | 427 | 1032-3369 | 1063 | 45 | 1127 | 240 | 934-2379 | 1009 | 62 | 1089 | 279 | 978-2731 | 1012 |

TABLE 3.5
 FTE Costs: Means and Ranges for the
 Total Sample for Each Year

| Cost Variable | | Year One | | | Year Two | | | Year Three | | |
|---------------------|-------|--------------|--------------------------|--------------------------|--------------|--------------------------|--------------------------|--------------|--------------------------|--------------------------|
| | | Total Sample | Without Speech & Hearing | Without Special Students | Total Sample | Without Speech & Hearing | Without Special Students | Total Sample | Without Speech & Hearing | Without Special Students |
| Instructional Cost | Mean | \$868 | \$868 | \$782 | \$949 | \$947 | \$886 | \$1064 | \$1064 | \$978 |
| | Range | 630-2734 | 630-2734 | 630-1034 | 615-2388 | 615-2388 | 615-1127 | 785-3959 | 785-3809 | 785-1215 |
| Administrative Cost | Mean | 56 | 56 | 56 | 58 | 58 | 58 | 71 | 71 | 71 |
| | Range | 48-61 | 48-61 | 48-61 | 55-64 | 55-64 | 55-64 | 64-83 | 64-83 | 64-83 |
| Related Cost | Mean | 70 | 70 | 70 | 74 | 74 | 74 | 82 | 82 | 82 |
| | Range | 54-89 | 54-89 | 54-89 | 50-82 | 50-82 | 50-82 | 49-100 | 49-100 | 49-100 |
| Total Cost | Mean | 994 | 994 | 909 | 1081 | 1079 | 1018 | 1230 | 1218 | 1132 |
| | Range | 740-2842 | 740-2842 | 740-1173 | 745-2527 | 745-2527 | 745-1267 | 934-4090 | 934-3979 | 934-1385 |
| Sample Size | | n=243 | n=243 | n=209 | n=249 | n=249 | n=219 | n=218 | n=218 | n=205 |

TABLE 3.6

Correlation Coefficients and Significance Probabilities
Between Cost Variables and Self-Concept Variables
For All Students, 1981-82

| SOS Variables | Cost Variables | | | | | |
|------------------|----------------|----------|---------|---------|---------|----------|
| | Kidcost | Costeach | ReadFTE | WordFTE | MathFTE | NumbrFTE |
| AKSEPTS | -.066* | -.068 | -.062 | -.064 | -.076 | -.072 |
| | .338 | .317 | .366 | .349 | .267 | .293 |
| SEKURTS | -.005 | -.009 | -.003 | -.004 | -.021 | -.029 |
| | .942 | .898 | .960 | .959 | .756 | .668 |
| MATURTS | -.088 | -.090 | -.066 | -.091 | -.079 | -.077 |
| | .199 | .188 | .338 | .186 | .247 | .263 |
| CONFITS | -.152 | -.152 | -.137 | -.134 | -.128 | -.164 |
| | .026 | .026 | .045 | .051 | .063 | .016 |
| SKULATS | .088 | .010 | -.014 | -.044 | -.054 | -.066 |
| | .899 | .876 | .842 | .526 | .433 | .335 |
| TCHRATS | -.042 | -.040 | -.035 | -.015 | -.055 | -.086 |
| | .541 | .565 | .614 | .833 | .428 | .209 |
| PEFRATS | -.113 | -.117 | -.102 | -.117 | -.099 | -.100 |
| | .099 | .090 | .138 | .087 | .152 | .144 |

N = 213 Students

TABLE 3.7

Correlation Coefficients and Significance
Probabilities Between Cost Variables
and Self-Concept Variables For
Non-Special Students, 1981-82

| SOS Variables | Cost Variables | | | | | |
|------------------|----------------|----------|---------|---------|---------|----------|
| | Kidcost | Costeach | ReadFTE | WordFTE | MathFTE | NumbrFTE |
| AKSEPTS | .043* | .038 | .041 | .045 | .011 | .012 |
| | .546 | .590 | .558 | .522 | .871 | .871 |
| SEKURTS | -.016 | -.028 | .010 | .004 | -.085 | -.084 |
| | .821 | .690 | .887 | .953 | .228 | .232 |
| MATURTS | .098 | .098 | .102 | .118 | .067 | .037 |
| | .135 | .164 | .149 | .095 | .341 | .605 |
| CONFITS | -.005 | -.002 | .042 | .059 | .074 | -.092 |
| | .042 | .976 | .553 | .407 | .729 | .195 |
| SKULATS | -.002 | .001 | .024 | .025 | -.011 | -.031 |
| | .981 | .985 | .726 | .721 | .881 | .657 |
| TCHRATS | -.031 | -.025 | .027 | .040 | -.039 | -.103 |
| | .666 | .727 | .708 | .568 | .584 | .145 |
| PEERATS | .023 | .017 | .041 | .034 | -.003 | .029 |
| | .741 | .803 | .565 | .631 | .962 | .729 |

N = 202 Students

*Correlations are on first line and significance probabilities are on second line of each comparison.

The correlations are remarkable only in that they reveal no discernible pattern of any practical significance. Almost all the correlations in Table 3.6 are negative, indicating a tendency for SOS scores to be lower as cost increases. The only SOS variable with correlations close to statistical significance is self-confidence (CONFITS) where the significance probabilities range from .016 to .063, and the correlations range from $-.164$ to $-.128$, respectively. However, these correlations are too low to be of any practical significance to teachers or administrators.

Table 3.7 shows the relationships among the variables when special students are removed. The first observation of importance when Tables 3.6 and 3.7 are compared is that many of the correlations move from a negative value to a positive value. The effect of removing the special students was to neutralize the relationship between costs and self-concept scores. There are fewer significant correlations in Table 3.7 than in Table 3.6.

Only the correlations for 1981-82 are shown, although correlations also were computed for the two previous years. The correlations for both 1979-80 and 1980-81 were very similar to the 1981-82 correlations shown in Tables 3.6 and 3.7. Regression analyses also were run for the seven SOS variables on KIDCOST. These analyses revealed no significant relationships and consequently the statistics will not be reported. The regression analyses on these data confirmed what was anticipated after studying the correlations in Tables 3.6 and 3.7, i.e., there was no observable pattern or discernible relationship between costs and self-concept scores for this sample of students.

Cost and Time On-Task

The next relationship of interest was that between cost and time on-task. The time on-task measures used in these analyses were expressed in minutes, not in percentage of time on-task. The dependent variables of interest were:

TOTLTIME: The total time on-task across all five subjects and across all five on-task modes. A student's total time on-task was an average of the three observations made each year.

READTOT: The total time on-task during reading instruction across all five on-task modes.

WORDTOT: The total time on-task during reading, language arts and social studies across all five on-task modes.

MATHTOT: The total time on-task during instruction in mathematics across all five on-task modes.

NUMBRTOT: The total time on-task during instruction in mathematics and science across all five on-task modes.

The correlations between the cost variables and the time on-task variables are shown in Tables 3.8 and 3.9. Once again, only the 1981-82 correlations are presented. Table 3.8 shows the correlations for all students, and Table 3.9 includes data on non-special students only.

These tables do not reveal the inconsistency in these correlations over the three years of the study. For example, the correlations for all students in 1979-80 all were negative and ranged from $-.087$ to $-.539$. In 1980-81, the correlations moved toward neutrality and ranged from $-.204$ to $.252$. Table 3.8 shows the same variables for 1981-82, and most of the correlations are positive (with the exception of NUMBRTOT), ranging from $-.085$ to $.378$.

The inconsistencies with respect to the non-special students are even greater. Correlations based on 1979-80 data all were negative and ranged from $-.122$ to $-.765$. For 1980-81, the correlations ranged from $-.183$ to $.455$. Table 3.9 shows the same variables for the 1981-82 with correlations ranging from $.231$ to $.584$, all of which are significant at $.001$ level or greater.

The contrasts between the data presented in Tables 3.8 and 3.9 also are interesting. The correlations between cost variables and time on-task variables are all positive and significant for the non-special students. When special students are included (as shown in Table 3.8), the correlations are reduced significantly. The correlation between KIDCOST and TOTLTIME dropped from $.546$ to $.148$ when special students were included. The same comparison for 1979-80 shows that all correlations were negative for both the all-student comparison and the non-special comparison, but when the special students were removed the correlations become even more negative--just the opposite of the 1981-82 comparison that can be seen in Tables 3.8 and 3.9. For example, the correlation between KIDCOST and TOTLTIME in 1979-80 went from $-.539$ to $-.766$ when special students were removed from the sample.

An explanation of these findings is elusive. It seems reasonable that as the high-cost special students, who tend not to be on-task oriented, are removed from the sample, the positive relationship between cost per pupil and time-on-task should increase. This happened in 1981-82; it did not happen in 1979-80. It is known that time on-task increased over the period of the study, as did the costs. Obviously there was a reversal from the early years, when time on-task and costs all were negatively correlated. Another possible explanation is that there may have been unreliable data, particularly in the first year of the study, either in the time on-task measures or the cost measures. In any event, the correlations show rather marked inconsistencies, and it was decided not to carry the analysis further than simply regressing total time on-task on KIDCOST, the results of which are displayed in Tables 3.10 and 3.11. Table 3.10 covers all three years and is for the samples that included all students and non-special students.

A great deal of caution should be exercised in interpreting the data in Tables 3.10 and 3.11. The problem, as expressed above, is that the results are very inconsistent from one year to the next. For both samples of students (all students and non-special students), the

TABLE 3.8

Correlation Coefficients and Significance
Probabilities Between Cost Variables
and Time On-Task Variables For
All Students, 1981-82

| Time-on-Task Variables | Cost Variables | | | | | |
|------------------------|----------------|----------|---------|---------|---------|----------|
| | Kidcost | Costeach | ReadFTE | WordFTE | MathFTE | NumbrFTE |
| Totltime | .148* | .122 | .378 | .012 | .184 | .159 |
| | .040 | .091 | .000 | .874 | .010 | .028 |
| Readtot | .223 | .197 | .297 | .152 | .124 | .106 |
| | .001 | .004 | .000 | .027 | .072 | .126 |
| Wordtot | .181 | .157 | .368 | .071 | .159 | .132 |
| | .012 | .030 | .000 | .325 | .028 | .067 |
| Mathtot | .086 | .078 | .051 | .078 | .039 | .002 |
| | .208 | .251 | .460 | .252 | .569 | .973 |
| Numbrtot | -.056 | -.061 | -.050 | -.085 | -.015 | -.010 |
| | .414 | .376 | .470 | .216 | .822 | .883 |

N = 192 to 215

TABLE 3.9

Correlation Coefficients and Significance
Probabilities Between Cost Variables
and Time On-Task Variables for
Non-Special Students, 1981-82

| Time-On-Task Variables | Cost Variables | | | | | |
|------------------------|----------------|----------|---------|---------|---------|-----------|
| | Kidcost | Costeach | ReadFTE | WordFTE | MathFTE | Numbr FTE |
| Totltime | .546* | .532 | .530 | .483 | .449 | .329 |
| | .000 | .000 | .000 | .000 | .000 | .000 |
| Readtot | .462 | .432 | .412 | .401 | .336 | .261 |
| | .000 | .000 | .000 | .000 | .000 | .000 |
| Wordtot | .486 | .462 | .518 | .401 | .363 | .266 |
| | .000 | .000 | .000 | .000 | .000 | .000 |
| Mathtot | .584 | .587 | .563 | .615 | .484 | .293 |
| | .000 | .000 | .000 | .000 | .000 | .000 |
| Numbertot | .326 | .331 | .255 | .329 | .312 | .231 |
| | .000 | .000 | .000 | .000 | .000 | .000 |

N = 185 to 204

*Correlations are on first line and significance probabilities are on second line of each comparison.

TABLE 3.10

Regression Analysis of Total Time On-Task On
Kidcost For All Students and Non-Special Students For
Each of Three Years

| Sample and Year | F Value | Probability > F | R ² |
|----------------------|---------|-----------------|----------------|
| All Students 1979-80 | 79.56 | .0001 | .291 |
| " " 1980-81 | 1.67 | .1973 | .007 |
| " " 1981-82 | 4.28 | .0399 | .022 |
| Non-Specials 1979-80 | 244.99 | .0001 | .586 |
| " " 1980-81 | 1.10 | .2963 | .006 |
| " " 1981-82 | 77.74 | .0001 | .298 |

TABLE 3.11

Regression Analysis of Total Time On-Task
on Kidcost For All Students and Non-Special
Students Over Three Years

| Sample | F Value | Probability > F | R ² |
|----------------------|---------|-----------------|----------------|
| All Students | 18.596 | .0001 | .064 |
| Non-Special Students | 34.70 | .0001 | .132 |

relationship between time on-task and KIDCOST is negative the first year, neutral the second year and positive the third year. As these relationships did not explain very much of the variance in time on-task, it was decided to conduct one additional analysis to compare time on-task with KIDCOST over an average of the three years. That is, KIDCOST and time on-task for each student were averaged over the three-year period, and time on-task was regressed on KIDCOST. The results are shown in Table 3.11 and indicate significant F values for both samples of students. It should be noted that the correlations between KIDCOST and TOTLTIME were again negative for both samples; that is, as cost increased, total time on-task decreased.

The results of this analysis did not sharpen our image of the relationship between time-on-task and cost. Only 13% of the variance in time on-task could be explained by KIDCOST for non-special students and only 6% for all students. If there is a relationship between these variables, it is inconsistent and elusive. The most plausible explanation, based on the longitudinal data analyzed in Table 3.11, is that these schools were spending more time, energy, and money on the special or marginal student, and these students were not necessarily the ones that were observed to be on-task.

Cost and Achievement

The relationships of primary interest in this phase of the study were between the cost variables and the achievement variables. Each of these variables was discussed in an earlier part of this section. The independent variables to be discussed in this section are KIDCOST, COSTEACH, READFTE, MATHFTE, and NUMBRFTE. The dependent variables are READSS, MATHSS, DIFFREAD and DIFFMATH. READSS and MATHSS are standardized achievement scores obtained on each student in each of the three years. DIFFREAD and DIFFMATH are the standardized achievement-score gains by each student between year one and year three. All of the independent cost variables were adjusted for inflation with the price deflator index discussed earlier. When the dependent variables DIFFREAD and DIFFMATH were regressed on the cost variables, the cost variables used were an average for each student across the three years. As with the previous analyses discussed, correlations and regressions were run on two samples of students--all students and non-special students only.

Table 3.12 shows the correlations between the cost variables and achievement variables for the sample of all students for each year of the study. Table 3.13 shows the correlations between the cost variables and achievement variables for the sample consisting of non-special students only for each year of the study.

The most remarkable characteristic of the correlations shown in Table 3.12 is the fact that they all are negative. That is, there is an inverse relationship between cost and achievement, i.e., the higher-cost students were achieving at lower levels on the standardized tests. No clear pattern is observable. The negative correlations of the cost variables with DIFFREAD and DIFFMATH increase over the three years, but it must be remembered that both DIFFREAD and DIFFMATH are constant while each of the cost variables increases over time. These correlations are

TABLE 3.12

Correlation Coefficients Between Cost Variables and Achievement Variables For All Students Across Three Years

| Achievement Variables and Year | Cost Variables | | | | | |
|--------------------------------|----------------|----------|---------|---------|---------|----------|
| | Kidcost | Costeach | ReadFTE | WordFTE | MathFTE | NumbrFTE |
| ReadSS 79-80 | -.402 | -.391 | -.397 | -.432 | -.351 | -.355 |
| 80-81 | -.276 | -.286 | -.241 | -.232 | -.257 | -.280 |
| 81-82 | -.370 | -.378 | -.298 | -.361 | -.311 | -.324 |
| MathSS 79-80 | -.398 | -.390 | -.407 | -.413 | -.064 | -.115 |
| 80-81 | -.217 | -.227 | -.221 | -.180 | -.236 | -.258 |
| 81-82 | -.285 | -.292 | -.220 | -.276 | -.238 | -.273 |
| DIFFRead 79-80 | -.092 | -.096 | -.064 | -.063 | -.125 | -.106 |
| 80-81 | -.159 | -.162 | -.090 | -.128 | -.149 | -.127 |
| 81-82 | -.197 | -.192 | -.167 | -.170 | -.172 | -.181 |
| DIFFMath 79-80 | -.112 | -.102 | -.115 | -.136 | -.069 | -.075 |
| 80-81 | -.124 | -.132 | -.135 | -.159 | -.039 | -.072 |
| 81-82 | -.128 | -.133 | -.054 | -.132 | -.049 | -.093 |

TABLE 3.13

Correlation Coefficients Between Cost Variables and Achievement Variables For Non-Special Students Across Three Years

| Achievement Variables and Year | Cost Variables | | | | | |
|--------------------------------|----------------|----------|---------|---------|---------|----------|
| | Kidcost | Costeach | ReadFTE | WordFTE | MathFTE | NumbrFTE |
| ReadSS 79-80 | -.033 | .005 | -.077 | -.113 | .119 | -.034 |
| 80-81 | .037 | .033 | -.045 | .095 | .028 | -.079 |
| 81-82 | -.130 | -.150 | -.124 | -.074 | .132 | -.188 |
| MathSS 79-80 | -.065 | -.040 | -.109 | -.122 | .065 | .020 |
| 80-81 | .112 | .109 | -.023 | .111 | .114 | -.016 |
| 81-82 | -.039 | -.057 | -.007 | .040 | -.075 | -.184 |
| DIFFRead 79-80 | .112 | .102 | .129 | .166 | -.002 | .062 |
| 80-81 | -.010 | -.013 | .041 | -.025 | .059 | .080 |
| 81-82 | -.210 | -.215 | -.213 | -.203 | -.134 | -.140 |
| DIFFMath 79-80 | -.102 | -.076 | -.147 | -.152 | .028 | -.022 |
| 80-81 | -.023 | -.034 | -.102 | -.019 | .028 | -.069 |
| 81-82 | -.053 | -.066 | .022 | -.048 | -.073 | -.191 |

Note: Correlations greater than .221 are significant at the .001 level or greater.

not robust but are relatively consistent over time, and all of them are negative.

Table 3.13 shows the correlation coefficients for the non-special students. They are less negative (more neutral) than the correlations for the all-student sample. Still, a majority of the correlations for the non-special students are negative. It should be noted that many of the correlations in Table 3.12 are significant at the .001 level or greater, while none of the correlations in Table 3.13 are statistically significant.

Regression analyses were run on every possible combination of cost and achievement variables shown in Tables 3.12 and 3.13. Table 3.14 reports the regression results for achievement scores in reading (READSS) and math (MATHSS) on KIDCOST for both samples of students over all three years. The results were consistent with the correlations shown in the previous tables. The F values all are statistically significant for the sample that included all students. The amount of variance explained in the achievement variables was highest in 1979-80 for reading at 16.1% and also for mathematics at 15.8%. The variance explained declined substantially in the second year and increased slightly in the third year. None of the R^2 's were large enough to be of practical importance. The results for the non-special sample of students also are shown in Table 3.14. None of the probabilities was significant, and none of the R^2 's was greater than 2%.

Table 3.15 shows the results of the regressions of reading costs (READFTE) per pupil and word-related instruction costs (WORDFTE) on reading achievement (READSS) for both samples of students and for each year of the study. All the F values were significant for the sample with all students, and none of the F values were significant for the non-special sample of students. The R^2 's in reading achievement were not of sufficient magnitude to have practical value.

Table 3.16 shows the results of the regressions of mathematics costs (MATHFTE) and mathematics related instructional costs (NUMBRFTE) on mathematics achievement (MATHSS) for both samples of students and for each year of the study. The effects of leaving the special students in the sample are shown by the fact that all the F values were significant for the sample with all students, and none of the F values was significant when the special students were removed from the analysis. The cost variables accounted for too little of the variance in mathematics achievement to be of any practical value.

The result of the final two analyses are shown in Tables 3.17 and 3.18. The comparison of interest in Table 3.17 was whether total instructional cost (KIDCOST), mathematics instructional costs (MATHFTE) or number-related instructional costs (NUMBRFTE) were significantly related to the increase (or decrease) in mathematics test scores over the three years of the study (DIFFMATH). Table 3.17 shows the regression results for both samples of students. None of the F values was significant, and the coefficient of determination accounted for less than 2% of the variance in all comparisons. A similar analysis was performed for reading, and the results are shown in Table 3.18. The results were very similar to those obtained for mathematics. The correlations between costs and reading gain scores and between costs and

TABLE 3.14

Regression Results of Achievement Scores
on Kidcost for All Students and Non-Special
Students for All Three Years

| Comparison and Year | F Value | Probability > F | R ² | |
|------------------------------------|---------|-----------------|----------------|------|
| Kidcost vs. ReadSS All Students | 1979-80 | 44.08 | .0001 | .161 |
| | 1981-81 | 19.95 | .0001 | .076 |
| | 1981-82 | 33.39 | .0001 | .137 |
| Kidcost vs. MathSS All Students | 1979-80 | 43.07 | .0001 | .158 |
| | 1980-81 | 11.92 | .0007 | .047 |
| | 1981-82 | 18.38 | .0001 | .081 |
| Kidcost vs. ReadSS Non-Specials | 1979-80 | .22 | .640 | .001 |
| | 1980-81 | .30 | .584 | .001 |
| | 1981-82 | 3.41 | .066 | .017 |
| Kidcost vs. MathSS Non-Specials | 1979-80 | .86 | .356 | .004 |
| | 1980-81 | 2.74 | .010 | .013 |
| | 1981-82 | .30 | .583 | .002 |

TABLE 3.15

3.31

Regression Results of Reading Achievement
Scores on ReadFTE and WordFTE For All Students
and Non-Special Students For All Three Years

| Comparison and Year | F Value | Probability > F | R ² |
|------------------------------------|---------|-----------------|----------------|
| ReadSS vs. ReadFTE All Students | 1979-80 | 42.79 | .158 |
| | 1980-81 | 14.99 | .058 |
| | 1981-82 | 20.50 | .089 |
| ReadSS vs. WordFTE All Students | 1979-80 | 52.68 | .187 |
| | 1980-81 | 13.76 | .054 |
| | 1981-82 | 31.45 | .130 |
| ReadSS vs. ReadFTE Non-Specials | 1979-80 | 1.20 | .006 |
| | 1980-81 | .44 | .002 |
| | 1981-82 | 3.11 | .015 |
| ReadSS vs. WordFTE Non-Specials | 1979-80 | 2.60 | .013 |
| | 1980-81 | 1.94 | .009 |
| | 1981-82 | 1.11 | .006 |

TABLE 3.16

Regression Results of Math Achievement Scores
on MathFTE and NumbrFTE For All Students
and Non-Special Students For All Three Years

| Comparison and Year | F Value | Probability > F | R ² |
|-------------------------------------|---------|-----------------|----------------|
| MathSS vs. MathFTE All Students | 1979-80 | 32.87 | .126 |
| | 1980-81 | 14.27 | .056 |
| | 1981-82 | 12.49 | .057 |
| MathSS vs. NumbrFTE All Students | 1979-80 | 35.81 | .135 |
| | 1980-81 | 17.25 | .067 |
| | 1981-82 | 16.77 | .075 |
| MathSS vs. MathFTE Non-Specials | 1979-80 | .86 | .004 |
| | 1980-81 | 2.83 | .013 |
| | 1981-82 | 1.10 | .006 |
| MathSS vs. NumbrFTE Non-Specials | 1979-80 | .153 | .000 |
| | 1980-81 | .054 | .000 |
| | 1981-82 | 6.880 | .034 |

TABLE 3.17

Regression Results of DIFFMath On
Kidcost, MathFTE, and NumbrFTE For All
Students and Non-Special Student Samples

| Comparison | F Value | Probability>F | R ² |
|---------------------------------------|---------|---------------|----------------|
| DIFFMath vs. Kidcost All Students | 3.17 | .077 | .018 |
| DIFFMath vs. MathFTE All Students | .62 | .434 | .003 |
| DIFFMath vs. NumbrFTE All Students | 1.35 | .247 | .008 |
| DIFFMath vs. Kidcost Non-Specials | .47 | .494 | .003 |
| DIFFMath vs. MathFTE Non-Specials | .22 | .639 | .001 |
| DIFFMath vs. NumbrFTE Non-Specials | 1.53 | .219 | .010 |

TABLE 3.18

Regression Results of DIFFRead on Kidcost,
ReadFTE and WordFTE For All Student
and Non-Special Student Samples

| Comparison | F Value | Probability>F | R ² |
|--------------------------------------|---------|---------------|----------------|
| DIFFRead vs. Kidcost All Students | 4.85 | .029 | .026 |
| DIFFRead vs. ReadFTE All Students | 4.21 | .042 | .023 |
| DIFFRead vs. WordFTE All Students | 3.83 | .052 | .021 |
| DIFFRead vs. Kidcost Non-Specials | .35 | .554 | .002 |
| DIFFRead vs. ReadFTE Non-Specials | .02 | .899 | .000 |
| DIFFRead vs. WordFTE Non-Specials | .32 | .571 | .002 |

mathematics gain scores were negative for all variables in the sample that included all students, and most correlations were negative for the sample of non-special students.

Discussion

This section of the report deals with the analysis of data on the student-specific instructional costs associated with more than 200 children in four school districts over a period of three years. While there was some variation in costs between and among schools and subject matter areas, the costs were highest for reading and mathematics in the third grade, and for reading and language arts in the fifth grade. The cost per pupil for mathematics and language arts decreased as a share of the total instructional cost over the three years, while the cost per pupil for language arts, science and social studies increased as a share of total instructional cost.

It was apparent very early that when the special students were removed from the sample, we were dealing with a very limited range of costs across the regular students in the sample. In the first year, the range was \$740 to \$1173; in the second year, it was \$745 to \$1267; and in the third year, the range was \$934 to \$1385. The differentials were \$433, \$522 and \$451, respectively. Most authorities would agree that an adequate education could be obtained at these expenditure levels. The problem that these limited ranges presented for this research was that there was relatively little variation in the costs per non-special pupil, although the variation increased considerably when special students were added to the sample. The effect of including the special students in the analyses was to increase the variation in both the cost variables and the dependent variables to the point where a few outlying students with very deviant measures could cause the correlations and regressions to be statistically significant.

Cost and Self-Concept

In the comparison between costs and self-concept in the sample with special students included, self-concept tended to move inversely with costs. This is a reasonable tendency since it is known that the special students incurred higher costs, and that they tended to have lower self-concepts. The regression analysis data confirmed that there was no statistically significant relationship between costs and self-concept scores for the sample that excluded special students. Regression analysis produced no equations in which significance probabilities greater than .10 were obtained.

Cost and Time On-Task

The relationships between cost and time on-task were inconsistent and defied explanation. The correlations between cost and time on-task for the total sample all were negative and ranged from $-.087$ to $-.539$

for grade 3. In the fourth grade, they moved closer to neutrality and ranged from $-.204$ and $.252$. Almost all of the correlations for the fifth grade were positive. The correlations between cost and time on-task for the sample that excluded special students were even more difficult to explain. All correlations for the third grade were negative; for grade 4, they included both positive and negative values; and for the fifth grade, all of the correlations were positive.

Costs explained very little of the variance in the time on-task variable in the fourth- and fifth-grade years for all students and in the fourth grade for the non-special sample. The variance explained in the third grade for all students was 29%, 59% in grade 3 for non-special students, and 30% in grade 5 for non-special students.

The teachers in our sample seemed to be spending more time, energy, and money on special or marginal students, and these students were not necessarily the ones found to be on-task a high percentage of the time. However, the correlations between cost and time on-task changed from negative to positive over the three years. We can only speculate that one or more of the following actions may have occurred: (1) time devoted to special students or students who were often not on-task decreased; (2) the number of special students decreased; (3) teachers receiving higher salaries spent more time with on-task students; or (4) teachers spent more time with task-oriented students.

Cost and Achievement

The primary relationship of interest in this study was that between cost and student achievement. For the total sample of students, the correlations between all cost variables and all achievement variables were negative, and most of them were statistically significant for all three years of the study. That is, as cost increased, student achievement test scores declined. This is consistent with the finding that the schools in our sample devoted relatively more resources to the special or marginal student, and these students did not always perform well on standardized tests.

Correlations between costs and achievement for the non-special sample of students were almost all in the neutral range, and none of them were statistically significant. That is, when special students were excluded from the sample, it appears that the schools and the teachers were allocating resources among students in a manner unrelated to their performance on achievement tests. The regression analyses produced statistically significant F values for all comparisons using the total sample of students but the F values for regression analyses using non-special students were not statistically significant. When the average cost per pupil over three years (adjusted for inflation) was compared with achievement gains of students between the first and third years of the study, little if any relationship was found between cost and achievement for either the sample including all students or the sample with special students excluded.

The results reported and discussed in this section must be interpreted with great caution. Obviously, generalizations beyond the schools which comprised the sample are unwarranted. It does appear, however, that in the schools we studied, more time, money and other resources were being allocated to special or marginal students than to regular students. It also appears that resources were rather equally distributed across students once special students were eliminated from the sample. There was a statistically significant negative relationship between costs and time on-task and between costs and achievement when the total sample was analyzed on a year-by-year basis. This significant relationship disappeared when these same comparisons were made with the regular students and with both samples of students in the longitudinal analyses.

These results are not surprising. As was suggested at the beginning of this section, most micro analyses have not revealed significant relationships between cost and achievement. If it were otherwise, there would be a basis for legal challenges to the way our school systems allocate resources to students. A positive and significant relationship between cost and achievement (as defined and derived in this study) would mean that more monetary and other resources were being allocated to those students who are doing well on achievement tests. Thus, the special, marginal, or average student would receive less resources. This scenario likely would not satisfy the parents or families of these children.

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SECTION IV

HOME ENVIRONMENT AND STUDENT ACHIEVEMENT*

Research in education has tended to focus upon activities that take place within the school and upon interactions between students and teachers. Studies of students' cognitive growth generally have sought to identify the teaching techniques and classroom arrangements that are most productive for different types of students. This approach recognizes that schools have little control over the lives of students during the time they are not in school. If out-of-school factors were totally unrelated to student development we would do well to ignore them, for there are few rights more sacrosanct in American culture than that of parents to raise their children as they see fit. However, many family and environmental factors have been shown to influence the social and intellectual growth of children.

Research on Home-School Relationships

In their review of the literature pertaining to family characteristics and student performance in schools, Iverson and Walberg (1982) identified four schools of research: the "socioeconomic school," the "family constellation school" (emphasizing family size and birth order, etc.), the "British school" (emphasizing parental attitudes and expectations), and the "Chicago school" (emphasizing family behavior and parent-child interactions). These are not competing schools of thought; researchers of one school seldom discredit the significance of work done by others. Certainly a complex mixture of socioeconomic, attitudinal, and behavioral characteristics of families, together with the ability and motivation of individual students and a multitude of school and community characteristics, must be sorted out before one can hope to understand why some students make rapid progress in school and others progress slowly or not at all.

Socioeconomic Factors and Student Achievement

The association of socioeconomic factors (e.g., the level of education attained by each parent, parental job status, and family income) with reading and mathematics achievement and measures of

* This section is based on the doctoral dissertation of Craig Olson. For a more detailed report of the analyses discussed in this section, see Olson, C. C. (1985). Relationships of parenting and aspects of the home environment to achievement and self concept of students in grades 3 to 5. Dissertation Abstracts International, in press. (University Microfilms No. 85-28,442).

affective development, such as self-concept and teacher affiliation, is well documented. There is little reason to believe that changes in education since 1966 have done much to diminish the strong relationship between socioeconomic status (SES) and cognitive growth identified by Coleman, et. al. (1966). In fact, the strength of the relationship seems to have increased. Dreeben (1983) replicated a 1969 study comparing first graders' reading aptitude with a number of other factors and reported a much stronger relationship between SES and aptitude in 1981 ($r = .48$) than had been observed in 1969 ($r = .12$). Bowles (1969) concluded that both the father's occupation and the availability of goods in the home (TV, telephone, appliances, study facilities, etc.) as measured by a "consumer durables index" were strong positive predictors of achievement. Heyns (1978) offered evidence that much of the SES-related difference in student achievement is due to differential gains and losses in learning during the summer vacation.

The mechanisms through which socioeconomic advantages are transmitted are not well understood. Furthermore, there is a conceptual problem involved with the use of SES factors as independent variables. They tend to conceal, within the cloak of a single index combining a variety of factors, the influences of individual factors which may vary considerably within a given SES level. An important cause/effect question thus remains unanswered: Are differences in socioeconomic status directly responsible for differences in observed levels of cognitive and affective development, or are both SES and student development manifestations of some third set of determinants? This question can be answered only by assessing the behavior of parents and children in the home and comparing differences in behavior with measures of the child's growth while controlling for each of the contributors to socioeconomic status.

Parent/Family Characteristics and Student Achievement

Several researchers have focused on the size, composition, and organization of the family as independent variables of interest. The abundance of research conducted in this field, as Henderson (1981) observed, may be due in part to the ease of collecting information about and controlling for variation among the family constellation variables. Students' intellectual development, as indexed by a variety of cognitive and affective measures, has been compared to family size, birth order, and birth interval. The employment status of each parent and the presence of other adults in the home have been examined. Adopted children have been compared to natural children, and children from single-parent and reconstituted households have been compared to those from households in which both natural parents are present.

Leibowitz (1977) identified negative relationships between family size and student performance, even when family SES was held constant. Zajonc, Markus and Markus (1979) presented a Confluence Model to explain their observation that IQ scores vary inversely with family size

and suggested that the critical causal factor is birth interval. They argued that intellectual development is a function of the richness of an individual's intellectual environment during early childhood which, in turn, is a function of the average intellectual ability level of all family members. Their Confluence Model has withstood numerous empirical tests and, according to both Ranssen (1983) and Walberg and Marjoribanks (1976), is particularly pronounced in families with poorly educated parents who were themselves unable to provide a rich intellectual environment for their first-born children.

Elder (1974) discovered that parental unemployment can adversely affect a child's performance in school, but the belief that maternal employment is not conducive to student achievement has been examined frequently and has not yet been substantiated (Leibowitz, 1977).

Father's absence has been shown to be detrimental to cognitive development (Sutton-Smith, Rosenberg and Landy, 1968). Its effects are more pronounced in boys than in girls, more pronounced in mathematics and related skills than in English and comprehension, and most pronounced if the child is nine years old or younger when he/she becomes fatherless.

Levine (1983) offered support for the hypothesis that differences in what families do, rather than family characteristics per se, influence achievement in school. He concluded that when other SES factors are held constant, only the level of education of the father contributed to the explanation of student achievement differences.

Bradley and Caldwell (1976) devised an instrument, the Home Observation for Measurement of the Environment (HOME), to measure environmental effects on mental-task performance with a sample of children at age three, and again at age four and one-half years. They concluded that when other environmental factors are held constant, socioeconomic factors do not appear to influence cognitive development. Among the six subscales they used, those measuring "maternal involvement with the child" and "the provision of appropriate play materials" were the best predictors of test performance. Disciplinary practices employed by the parents did not influence test results. The predictive value of five of the six HOME subscales remained relatively constant across an 18-month period. The sixth, "opportunities for variety in daily stimulation," declined in importance.

These studies are indicative of a trend away from examination of the readily quantifiable aspects of the child's external environment to the more qualitative aspects of the environment that many researchers believe to be the root causes of both the observed differences in student growth and performance and the SES and family characteristics that frequently have been used to explain these differences. Several researchers have examined endogenous variables such as attitudes and abilities of parents even though they are difficult to measure.

The available evidence does not, for example, support the supposition that close parental involvement in task completion is associated with higher levels of cognitive functioning. Crandall, et. al. (1964) observed that very low and very high levels of parental participation were detrimental to girls' mastery of various tasks, but moderate participation seemed to be beneficial. Radin (1981) added that paternal nurturance is negatively associated with boys' completion of tasks requiring mastery efforts. Boerger (1971) surveyed the fathers of fifth- and sixth-grade boys and concluded that, although the fathers of high achievers held high expectations for their sons, they were only indirectly involved in their son's academic activities.

Hill and Stafford (1974) discovered that high SES mothers spend two to three times more time caring for their children than low SES mothers, and that the labor-market involvement of high SES mothers increases rapidly by comparison with low SES mothers as their children grow older. This observation is consistent with the widely held belief that time is more important in raising young children, but that market inputs such as schooling costs, obtainable only with the fruits of employment, are more important for older children.

Other researchers have tried to isolate and examine individual facets such as time use, parent-child interact, and the allocation of educational resources in the home. Williams, et al. (1982), in a meta-analysis of 23 articles from four countries spanning a period of 26 years, reported a slight negative relationship between weekly hours of television viewing and student achievement, but noted the effect was small. Levine' (1983) work corroborated Williams' findings with regard to television viewing. He also noted, with some trepidation, that when other factors such as IQ and SES were held constant, there appeared to be a negative relationship between achievement in mathematics and reading and the amount of time a child spent (1) doing homework, (2) in the company of adults, (3) shopping with parents, and (4) eating dinner with other members of the family. Positive relationships were identified, however, between a child's achievement and (1) time spent playing alone, and (2) the amount of time parents spent reading to the child when the child was in preschool.

A preponderance of the studies that have examined associations between childrens' academic attainment and characteristics of their home environments have attempted to correlate one set of measures of home environment attributes with another set of measures of academic attainment. Although many associations have been identified between achievement and factors measuring socioeconomic status, family constellation, parents' attitudes and expectations for their children, and the quality and quantity of parent-child interactions, the dynamics of the relationships are not yet well understood. In addition, many of the studies have focused upon populations of urban and disadvantaged children. Whether, or to what extent, their findings may be generalized to populations with different demographic characteristics is not known.

Variables and Procedures

Data collected in this study permitted examination of associations between eight distinct sets of characteristics of the home environment of 198 elementary-school students and their cognitive and affective development, as measured by their performance on standardized achievement and self-concept tests. As described in greater detail in Section I, the students were located in two medium-size urban and two small-town/rural areas of Wisconsin and were followed from third to fifth (and in some cases, sixth) grades. Students' academic aptitude was assessed using the Otis-Lennon Mental Ability Test (OLMAT) in three schools and the Test of Cognitive Skills (TCS) in the fourth school. Their academic progress was monitored annually using the reading and mathematics sections of the Stanford Achievement Test (SAT). Students' perceptions of their self-concept and the quality of their relationships with their school, their teachers, and their peers also were assessed annually using the seven subscales of the Self-Observation Scales (SOS). (Katzenmeyer and Stenner, 1975).

A telephone interview was conducted with approximately one-third of the household during each year of the study. Most of the interviews were with the student's mother, although a few were conducted with the father. The interview protocol included 113 questions assessing eight aspects of the home environment: (1) the family constellation, (2) the child's and (3) the parent's use of time, (4) the parents' education and occupations and other socioeconomic characteristics, (5) the quantity and variety of reading materials in the home, (6) the parents' priorities for the child's involvement in extra-scholastic activities, (7) the quality and quantity of interactions between the parents and the child's school, and (8) the parent's opinion about the school and its success in meeting his or her child's needs. Twelve questions requesting the parent's perception of the child's opinion of the school also were included.

The first task in data analysis was to reduce the large pool of home environment variables to a more manageable size by factor and cluster analysis. Factor analysis of the entire variable pool yielded 13 orthogonal factors with characteristic roots greater than 2.0. Clusters of from five to ten variables highly correlated with each factor ($r = .30$) were identified. Of the 13 clusters, 10 were comprised of variables quite highly intercorrelated. In these cases, one or two variables exhibiting the highest correlation with the factor ($r = .56$ to $.92$) were selected as representative of the factor.

Next, a matrix of partial correlation coefficients between the 113 home environment variables and all self-concept, achievement, and growth-in-achievement variables was examined. The effects of students' academic aptitude (which was treated as a control variable) were partialled out. An exclusion rule was applied to eliminate all home environment variables that did not have significant ($p = .05$) partial correlations with either (1) two of the four measures of achievement in

reading or mathematics; (2) two of the measures of growth in reading or mathematics achievement (defined as change in SAT scaled scores over a one- or two-year interval); or (3) two of the three measures for each of the seven aspects of affective development assessed by the SOS instrument. Thus, each home environment variable could survive the initial cut based on its ability to serve as a proxy for other variables and/or by having at least one durable association with achievement, growth, or self-concept.

Conceptual Framework for the Data Analysis

The conceptual framework which guided the data analysis is portrayed in Figure 4.1. Of the 30 direct, indirect, and feedback relationships between input and output modes of the education-production process depicted in Table 4.1, five were examined in this research. The direct influence of eight aspects of the home environment on cognitive development (represented by A) were explored in some detail. The influence of seven measures of affective status on cognitive development (C) also was examined, and the extent to which these seven measures were themselves influenced by the home environment (B) was explored. In addition, relationships between invariant student characteristics (e.g., academic aptitude and gender) and cognitive development (D) and affective development (E) were examined. In this analysis, affective status was treated as an output with respect to the home environment and as an input with respect to cognitive development, i.e., as an index of the indirect effect of home environment on cognitive development.

The sample population was divided into five groups including (1) all 198 students; (2) 107 boys; (3) 91 girls; (4) high achievers; and (5) low achievers (i.e., students above the 75th and below the 25th sample population percentile on each reading and mathematics achievement index). For each group of students and for each of the home environment variables (HEV) surviving the initial screening, the following questions were posed.

1. Is the HEV systematically related to achievement?
2. If so, does the strength of the relationship appear to increase, decrease, or remain constant as the students mature?
3. Is the HEV systematically related to any of the affective (S)S measures which are themselves related to achievement or growth in reading or mathematics?
4. If so, does the strength of the relationship appear to increase, decrease, or remain constant as the students mature?

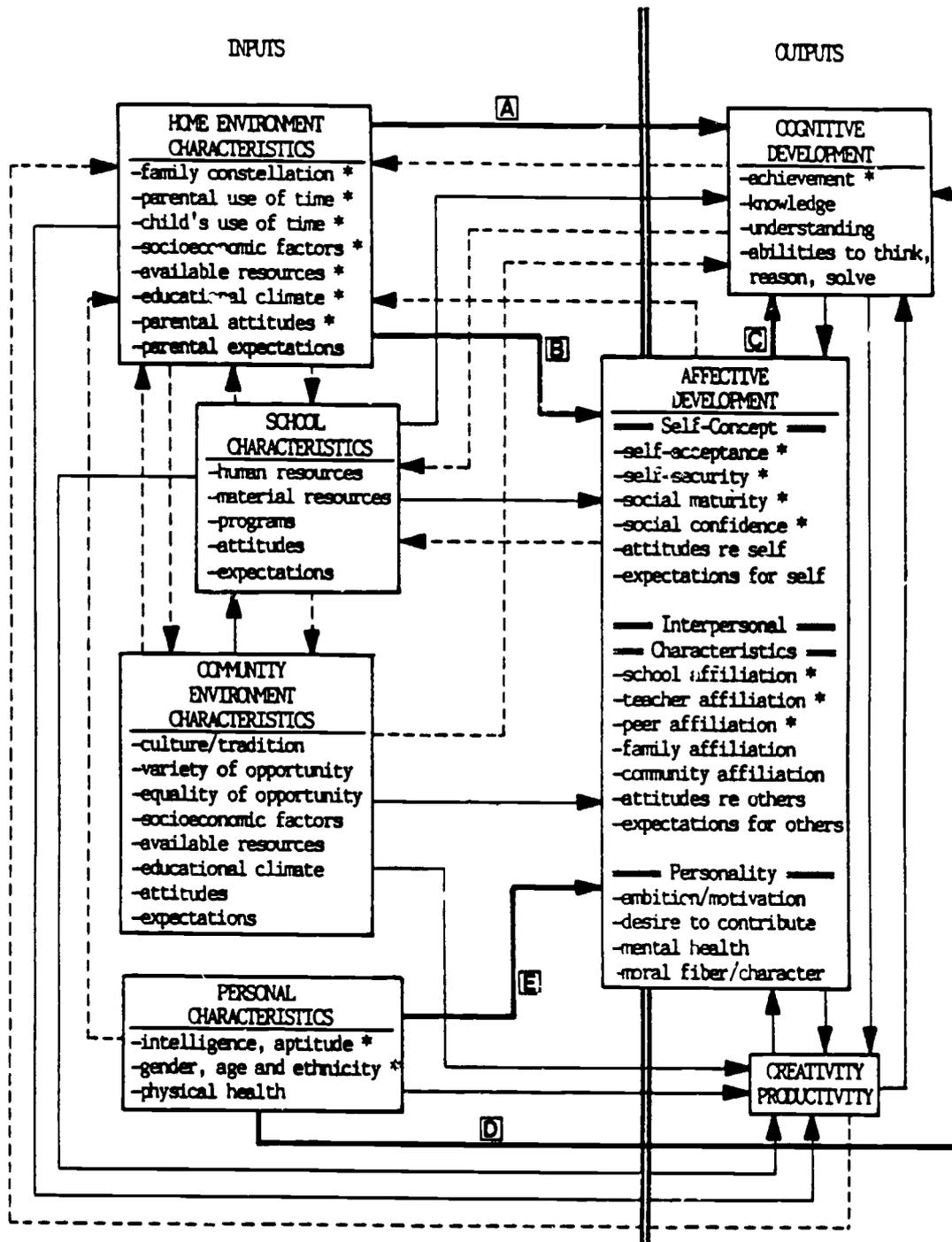


Fig. 4.1. A Conceptual Framework of the Education Production Process for Individual Students.
 —————> = moderate to strong influence; - - - - -> = weak influence.
 Absence of arrow indicates negligible or no influence. * = variable examined in this study.

Table 4.1

Correlations of CAI to Reading Achievement and Growth
for the Groups of Students Examined in this Study

| Academic attainment index | Total sample Schools 1-4 (N = 198) | | Boys (n = 107) | | Girls (n = 92) | | High achievers (n = 45-50) | | Low achievers (n = 45-50) | |
|---------------------------|------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|----------------|---------------------------|----------------|
| | Corr | R ² | Corr | R ² | Corr | R ² | Corr | R ² | Corr | R ² |
| 2 achv. | .482 | .232 | .417 | .174 | .587 | .345 | na | na | na | na |
| 3 achv. | .689 | .475 | .748 | .560 | .646 | .417 | .421 | .177 | .398 | .158 |
| 4 achv. | .568 | .323 | .576 | .331 | .585 | .342 | .193 | .037 | .100 | .010 |
| 5 achv. | .699 | .489 | .695 | .483 | .713 | .508 | .477 | .228 | .390 | .152 |
| 3-4 growth | nss | nss | nss | nss | .239 | .057 | na | na | na | na |
| 4-5 growth | .182 | .033 | nss | nss | nss | nss | na | na | na | na |
| 3-5 growth | .266 | .071 | nss | nss | .406 | .165 | .340 | .116 | .223 | .050 |

All reported coefficients are significant at the $p < .05$ level.

Correlations of CAI to Mathematics Achievement and Growth
for the Groups of Students Examined in this Study

| Academic attainment index | Total sample Schools 1-4 (N = 198) | | Boys (n = 107) | | Girls (n = 92) | | High achievers (n = 45-50) | | Low achievers (n = 45-50) | |
|---------------------------|------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------------------|----------------|---------------------------|----------------|
| | Corr | R ² | Corr | R ² | Corr | R ² | Corr | R ² | Corr | R ² |
| 2 achv. | .639 | .408 | .395 | .156 | .597 | .356 | na | na | na | na |
| 3 achv. | .621 | .386 | .542 | .294 | .657 | .432 | .198 | .039 | .573 | .328 |
| 4 achv. | .597 | .356 | .547 | .299 | .679 | .461 | .550 | .303 | nss | nss |
| 5 achv. | .684 | .468 | .619 | .383 | .707 | .500 | nss | nss | .525 | .276 |
| 3-4 growth | .249 | .062 | .316 | .100 | .390 | .152 | na | na | na | na |
| 4-5 growth | .299 | .089 | .245 | .060 | .366 | .134 | na | na | na | na |
| 3-5 growth | .475 | .226 | .318 | .101 | .421 | .177 | .282 | .080 | .465 | .216 |

All reported coefficients are significant at the $p < .05$ level.

CAI = cognitive aptitude index; na = not available; nss = not statistically significant.

gr. is the grade students were in when the achievement/growth index was obtained.

Corr is the zero-order coefficient of correlation between CAI and the achievement/growth index.

R² is the proportion of variance in the achievement/growth index explained by the CAI.

Questions 1 and 2 examined the direct path of influence depicted by A in Figure 4.1; questions 3 and 4 examined the indirect path of influence depicted by B and C in Figure 4.1. Two additional pathways, depicted by D and E in Figure 4.1, also were examined.

Previous research has indicated that personal characteristics of the student, such as intelligence, aptitude, gender, age, and ethnicity, have a direct bearing on each of the outputs of the educational process. Intelligence and cognitive aptitude unquestionably are important determinants of academic attainment and have been linked as well with each of the seven facets of affective development examined in this study (Katzenmeyer and Stenner, 1975). Distinct differences between males and females of this age group also were noted by Katzenmeyer and Stenner (1975). These differences favored females on teacher affiliation, self-acceptance, school affiliation, and social maturity, while males evidenced higher scores on self-security. No significant differences were evident between males and females on social confidence or peer affiliation. Stevens (1975) noted significant increases in social maturity, social confidence, and self-acceptance, a slight increase in peer affiliation, and a significant decline in school affiliation as students progressed through the intermediate grades.

Cognitive Aptitude and Academic Achievement

A major purpose of this aspect of the research was to gain greater understanding of the out-of-school factors that contribute to the academic achievement of elementary school students. The fact that a child's cognitive aptitude is an important contributor to his or her academic performance is self-evident, but there is much argument with regard to the measurement of cognitive aptitude and the tests used for this purpose. We have avoided use of the terms "intelligence" and "I.Q." in reference to the OLMAT and TES, and instead have used the term "cognitive aptitude index" (CAI). These tests are administered to groups of students, not to each student individually, and they do not purport to measure all important aspects of intellectual functioning. The TCS publishers, in fact, refer to individual student scores as a "cognitive skills index." In this research, the two instruments were regarded simply as devices for predicting scholastic success, specifically, predicting the student's performance and growth on the reading and mathematics portions of the SAT. Used in this limited way, ethnic and cultural bias and other problems sometimes associated with matters of intellect are not relevant. Rather, it is important:

- (1) that these CAI measures have proven to be reasonably stable;
- (2) that fluctuations in the CAI appear to be unrelated to fluctuations in the scholastic measures they are used to predict;
- (3) that the CAI was obtained at a point sufficiently early in the child's life that it may reasonably be assumed to be unrelated to his or her formal educational experiences;

- (4) that the CAI is strongly and consistently predictive of achievement; and
- (5) that it is inexpensive, simple to administer and easy to interpret.

Table 4.1 gives the zero order correlation between the CAI and each of the 14 measures of achievement and growth in reading and mathematics for the various groups of students. It also shows the proportion of variance in the specified achievement/growth index that was explained by the CAI. Based on the information summarized in Table 4.1, it is evident that the CAI was highly correlated with reading and mathematics achievement and quite highly correlated with reading and mathematics growth for all groups of students throughout the study. In most cases, the association between CAI and student achievement and growth was stronger for girls than for boys and for high achievers (top quartile) than for low achievers A (bottom quartile). In most instances, a slight but consistent increase in the predictive capacity of the CAI was noted. This was particularly true for mathematics achievement and growth for girls, boys, and all students, and for reading growth for all students.

Student Self-Concept and Academic Achievement

Studies during the past two decades have identified moderate to strong positive relationships between various aspects of students' self-concept and their academic attainment (Kaplin, 1969; Cummings, 1970; Binder, Jones, and Strong, 1970; Katzenmeyer and Stenner, 1976). Moderate to strong relationships between self-concept measures and an assortment of measures of ability (including verbal and nonverbal intelligence) also have been identified (Stenner and Katzenmyer, 1975). Brookover, Thomas, and Patterson (1964) reported a positive relationship between self-concept and student achievement with ability level controlled.

One objective of this research was to seek out and describe relationships between variables over which parents and educators have little, if any, control. For example, if A, an index of self-concept, is a reasonably good predictor of B, a desired educational outcome (e.g., reading achievement), it is important to know what portion of the association between A and B may be associated with uncontrollable factors U such as intelligence, gender, or age, and what portion of the association may be influenced by other factors C that are subject to the influence of parents, educators, and society. If U explains most of the association between A and B, little improvement in B can be anticipated as a result of efforts to change A. On the other hand, if U does not explain the A-B association, there is more reason to expect that efforts to increase B by changing A through C will have the desired result.

Table 4.2

Regression of Reading and Mathematics Achievement on CAI, Gender, and Self-Concept
(Total Sample)

| Dependent variable | Order entered | Regressor* | Multiple corr. | R^2 | Change in R^2 | Regress. coeffnt. | Partial F-value | Equation* properties |
|-----------------------------------|---------------|-------------|----------------|-------|-----------------|-------------------|-----------------|----------------------|
| 3rd grade achievement reading | 1 | CAI | .707 | .499 | .499 | 0.643 | 134.10 | c = 63.75 |
| | 2 | Sex | .717 | .514 | .015 | 3.3 | 4.08 | n = 163 |
| | 3 | Confid(-4)* | .725 | .526 | .012 | 0.21 | 4.00 | s = 10.3 |
| | 1 | CAI | .702 | .493 | .493 | 0.612 | 105.47 | c = 63.28 |
| | 2 | Confid(Avg) | .715 | .512 | .019 | 0.122 | 5.66 | n = 149 |
| | | | | | | | | s = 10.4 |
| 4th grade achievement reading | 1 | CAI | .575 | .331 | .331 | 0.671 | 79.39 | c = 65.31 |
| | 2 | TchAfl(-4) | .600 | .360 | .029 | 0.27 | 4.93 | n = 178 |
| | 3 | Sex | .615 | .378 | .018 | 5.2 | 4.88 | s = 15.0 |
| | 1 | CAI | .585 | .342 | .342 | 0.669 | 75.34 | c = 55.29 |
| | 2 | TchAfl(-5) | .617 | .381 | .039 | 0.31 | 4.49 | n = 163 |
| | 3 | Confid(-5) | .625 | .391 | .010 | 0.27 | 2.43 | s = 14.9 |
| 5th grade achievement reading | 1 | CAI | .577 | .333 | .333 | 0.660 | 60.53 | c = 56.30 |
| | 2 | TchAfl(Avg) | .607 | .368 | .035 | 0.201 | 8.12 | n = 149 |
| | | | | | | | s = 15.5 | |
| 5th grade achievement reading | 1 | CAI | .703 | .494 | .494 | 0.771 | 104.45 | c = 56.84 |
| | 2 | Confid(Avg) | .721 | .519 | .025 | 0.178 | 7.56 | n = 149 |
| | | | | | | | s = 13.2 | |
| 3rd grade achievement mathematics | 1 | CAI | .632 | .399 | .399 | 0.461 | 110.67 | c = 96.87 |
| | | | | | | | | n = 169 |
| | | | | | | | s = 8.69 | |
| 4th grade achievement mathematics | 1 | CAI | .603 | .364 | .364 | 0.567 | 89.11 | c = 88.00 |
| | 2 | TchAfl(-5) | .618 | .383 | .019 | 0.23 | 4.80 | n = 162 |
| | | | | | | | s = 11.8 | |
| 5th grade mathematics | 1 | CAI | .689 | .475 | .475 | 0.723 | 141.61 | c = 80.22 |
| | 2 | TchAfl(-5) | .700 | .490 | .015 | 0.22 | 4.45 | n = 162 |
| | | | | | | | s = 11.9 | |

*CAI = cognitive aptitude index, sex is coded: male = 1, female = 2; n = sample size; c = regression constant (alpha term); s = residual root mean square; R^2 is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.

Confid = Social Confidence; TchAfl = Teacher Affiliation

Regressors with F-values exceeding 2.7 and 3.9 are significant at the $p < .05$ and $p < .01$ levels, respectively, for reading

Regressors with F-values exceeding 3.1 and 4.7 are significant at the $p < .05$ and $p < .01$ levels, respectively, for mathematics

Table 4.3

Regression of Reading and Mathematics Growth on CAI, Gender, and Self-Concept
(Total Sample)

| Dependent variable | Order entered | Regressor* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|------------------------------|---------------|-------------|----------------|----------------|--------------------------|-------------------|-----------------|----------------------------------|
| Growth 3-4 reading | 1 | TchAfl(4) | .156 | .025 | .025 | 0.21 | 4.12 | c = -0.38 n = 163 s = 12.9 |
| | 1 | TchAfl(Avg) | .155 | .024 | .024 | 0.106 | 3.61 | c = -6.72 n = 149 s = 12.7 |
| Growth 4-5 reading | 1 | Sex | .211 | .045 | .045 | -4.9 | 6.66 | c = 3.82 n = 149 |
| | 2 | CAI | .269 | .072 | .027 | 0.127 | 4.24 | s = 11.6 |
| Growth 3-5 reading | 1 | Confid(-5) | .286 | .082 | .082 | 0.33 | 8.94 | c = -14.09 n = 149 |
| | 2 | CAI | .350 | .123 | .041 | 0.146 | 6.81 | s = 10.3 |
| Grade 3-4 growth mathematics | 1 | CAI | .276 | .076 | .076 | 0.159 | 13.03 | c = -3.15 n = 162 s = 8.61 |
| Grade 4-5 growth mathematics | 1 | CAI | .277 | .077 | .077 | 0.162 | 13.32 | c = -8.79 n = 161 s = 8.73 |
| Grade 3-5 growth mathematics | 1 | CAI | .480 | .230 | .230 | 0.255 | 30.58 | c = -16.96 n = 148 |
| | 2 | Matur(3) | .515 | .265 | .035 | 0.244 | 6.81 | s = 8.23 |
| | 1 | CAI | .480 | .230 | .230 | 0.285 | 41.09 | c = -14.54 n = 148 |
| | 2 | TchAfl(-5) | .497 | .247 | .017 | 0.136 | 3.20 | s = 8.33 |
| Grade 3-5 growth mathematics | 1 | CAI | .480 | .230 | .230 | 0.263 | 30.58 | c = -18.54 n = 148 |
| | 2 | Matur(Avg) | .497 | .247 | .017 | 0.085 | 3.17 | s = 8.33 |

*CAI = cognitive aptitude index; sex is coded: male = 1 female = 2; n = sample size; c = regression constant; s = residual root mean square; R² proportion of variance explained by the regression equation.

TchAfl = Teacher Affiliation; Confid = Social Confidence; Matur = Social Maturity.

Regressors with F-values exceeding 4.0 and 4.2 are significant at the $p < .05$ and $p < .01$ levels, respectively, for reading

Regressors with F-values exceeding 3.1 and 4.7 are significant at the $p < .05$ and $p < .01$ levels, respectively, for mathematics.

Stepwise linear regression with forward selection was employed to examine the relationship between reading and mathematics achievement and growth and the seven self-concept indices, the cognitive aptitude, and the gender of students. Each stepwise regression examined the association of a dependent variable (either achievement or growth) and the nine independent variables (or eight independent variables when gender was a criterion for group selection).

Tables 4.2-4.8 summarize the results obtained where achievement and growth in reading and mathematics were regressed on CAI, gender, and self-concept measures for the entire sample of students, for boys and girls, and for students in the bottom and top quartiles on the achievement distribution.

Examination of the data displayed in Tables 4.2 and 4.3 reveals that, with one exception, prediction of achievement or growth in reading and mathematics was not enhanced by prior knowledge of a student's level of affective development as measured by the seven SOS subscales. The single exception was the social maturity index for third graders, which contributed to the prediction of growth in mathematics from third through fifth grade. No other SOS index obtained at the end of third grade and no SOS index obtained at the end of fourth grade made a statistically significant contribution in the regressions predicting either achievement or growth in reading and mathematics. As expected, the CAI was a strong, durable predictor of reading and mathematics achievement, as well as mathematics growth. Surprisingly, however, it was not a potent predictor of growth in reading achievement scores.

Tables 4.4, 4.5, and 4.6 summarize the results when boys and girls were analyzed separately. The third-grade social maturity of boys was the single most powerful predictor of their growth in mathematics from third through fourth grade, and it also entered the equation (with CAI) to predict boys' growth in mathematics from third through fifth grade. Social maturity was the only SOS measure to enter the equation when boys' reading achievement and growth were regressed on CAI and self-concept.

Two SOS indices, teacher affiliation and social confidence, made small but consistent contributions to the explanation of variance in girls' achievement in both reading and mathematics. In only one instance, however, did knowledge of prior-year SOS scores provide information in addition to that provided by the CAI. Seven of the statistically significant associations between teacher affiliation, social confidence, and girls' achievement in reading and mathematics involved SOS indices obtained either concurrent with or a year later than the time when the achievement index was obtained. The results of the analysis provide strong evidence that academic achievement and social confidence are positively associated for girls, and that the association goes beyond the positive links between CAI and achievement and between CAI and social confidence. Teacher affiliation and social confidence also demonstrated positive associations with girls' academic growth. The SOS indices involved were obtained at the end of the period

Table 4.4

Regression of Boys' Reading and Mathematics Achievement and Growth on CAI and Self-Concept

| Dependent variable | Order entered | Regressor* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|---|---------------|------------|----------------|----------------|--------------------------|-------------------|-----------------|---------------------------------|
| 3rd grade achievement reading | 1 | CAI | .748 | .559 | .559 | 0.792 | 87.42 | c = 60.31 n = 71 s = 10.6 |
| 4th grade achievement reading | 1 | CAI | .576 | .332 | .332 | 0.67 | 36.24 | c = 81.07 n = 75 s = 14.2 |
| 5th grade achievement reading | 1 | CAI | .695 | .483 | 4.83 | 0.86 | 70.06 | c = 76.82 n = 77 s = 14.0 |
| Grade 3-4 Reading Growth-- no significant predictors entered with \bar{F} 4.0 | | | | | | | | |
| Grade 4-5 Reading Growth-- no significant predictors entered with \bar{F} 4.0 | | | | | | | | |
| Grade 3-5 Reading Growth-- no significant predictors entered with \bar{F} 4.0 | | | | | | | | |
| 3rd grade achievement mathematics | 1 | CAI | .542 | .294 | .294 | 0.389 | 28.30 | c = 105.3 n = 70 s = 9.00 |
| 4th grade achievement mathematics | 1 | CAI | .547 | .299 | .299 | 0.59 | 32.04 | c = 96.49 n = 77 s = 13.8 |
| 5th grade achievement mathematics | 1 | CAI | .619 | .383 | .383 | 0.636 | 45.83 | c = 102.2 n = 77 s = 12.6 |
| Grade 3-4 growth mathematics | 1 | Matur(3) | .369 | .136 | .136 | 0.63 | 8.88 | c = -36.83 |
| | 2 | CAI | .465 | .216 | .080 | 0.155 | 6.15 | n = 64 s = 7.63 |
| Grade 4-5 growth mathematics | 1 | CAI | .245 | .060 | .060 | 0.105 | 4.33 | c = -2.39 n = 70 s = 6.37 |
| Grade 3-5 growth mathematics | 1 | CAI | .318 | .101 | .101 | 0.172 | 5.95 | c = -19.02 |
| | 2 | Matur(3) | .397 | .158 | .057 | 0.45 | 4.04 | n = 63 s = 8.34 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term);

s = residual root mean square; R² is the coefficient of determination or

proportion of variance in the dependent variable explained by the regression equation.

Matur = Social Maturity

Regressors with partial F-values exceeding 4.0 and 5.0 are significant at the $p < .05$ and $p < .01$ levels respectively.

Table 4.5
REGRESSION OF GIRLS' READING AND MATHEMATICS ACHIEVEMENT ON CAI
AND SELF-CONCEPT

| Dependent variable | Order entered | Regressor* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|-----------------------------------|---------------|-------------|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd grade achievement reading | 1 | CAI | .646 | .417 | .417 | 0.499 | 47.33 | c = 14.57 n = 70 |
| | 2 | Confid(4) | .735 | .540 | .133 | 0.59 | 17.98 | s = 8.40 |
| | 1 | CAI | .644 | .415 | .415 | 0.425 | 33.29 | c = 47.52 n = 65 |
| | 2 | Confid(Avg) | .766 | .587 | .172 | 0.349 | 25.81 | s = 7.99 |
| 4th grade achievement reading | 1 | CAI | .585 | .342 | .342 | 0.67 | 39.82 | c = 29.14 n = 77 |
| | 2 | TchAfl(4) | .669 | .447 | .105 | 1.13 | 14.06 | s = 12.8 |
| | 1 | CAI | .570 | .325 | .325 | 0.65 | 31.47 | c = 58.64 n = 73 |
| | 2 | Confid(5) | .619 | .383 | .058 | 0.59 | 6.60 | s = 13.7 |
| | 1 | CAI | .567 | .322 | .322 | 0.57 | 21.90 | c = 1.55 n = 66 |
| | 2 | Confid(Avg) | .653 | .426 | .104 | 0.28 | 4.67 | s = 13.4 |
| 5th grade achievement reading | 1 | CAI | .718 | .515 | .515 | 0.763 | 61.00 | c = 27.91 n = 70 |
| | 2 | TchAfl(4) | .755 | .570 | .055 | 0.69 | 4.67 | s = 11.2 |
| | 3 | Confid(4) | .769 | .592 | .022 | 0.40 | 3.69 | n = 70 |
| | 1 | CAI | .734 | .539 | .539 | 0.733 | 59.14 | c = 30.12 n = 66 |
| | 2 | Confid(Avg) | .797 | .635 | .096 | 0.366 | 16.56 | n = 66 |
| 3rd grade achievement mathematics | 1 | CAI | .657 | .432 | .432 | 0.393 | 36.00 | c = 75.65 n = 65 |
| | 2 | Confid(Avg) | .701 | .492 | .060 | 0.167 | 7.40 | s = 7.10 |
| 4th grade achievement mathematics | 1 | CAI | .679 | .461 | .461 | 0.601 | 59.14 | c = 73.78 n = 78 |
| | 2 | Confid(4) | .711 | .506 | .045 | 0.41 | 6.92 | s = 9.39 |
| | 1 | CAI | .668 | .446 | .446 | 0.629 | 59.91 | c = 73.02 n = 73 |
| | 2 | TchAfl(5) | .691 | .478 | .032 | 0.36 | 4.37 | s = 9.75 |
| 5th grade achievement mathematics | 1 | CAI | .711 | .506 | .506 | 0.604 | 50.13 | c = 62.04 n = 66 |
| | 2 | Confid(Avg) | .742 | .551 | .045 | 0.202 | 6.25 | s = 9.37 |
| 5th grade achievement mathematics | 1 | CAI | .707 | .500 | .500 | 0.781 | 74.82 | c = 59.85 n = 72 |
| | 2 | TchAfl(5) | .733 | .538 | .038 | 0.46 | 5.62 | s = 10.8 |
| 5th grade achievement mathematics | 1 | CAI | .729 | .532 | .532 | 0.743 | 56.40 | c = 54.72 n = 65 |
| | 2 | Confid(Avg) | .751 | .564 | .032 | 0.207 | 4.54 | s = 10.9 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term);
s = residual root mean square; R² = proportion of variance in the dependent variable explained
by the regression equation.

Confid = Social Confidence; TchAfl = Teacher Affiliation.

Regressors with F-value exceeding 4.0 and 7.0 are significant at the $p < .05$ level and $p < .01$
levels, respectively, for mathematics.

All reported coefficients are significant at the $p < .05$ level for reading.

Table 4.6

Regression of Girls' Reading and Mathematics Growth on CAI and Self-Concept

| Dependent variable | Order entered | Regressor* | Multiple corr. | R^2 | Change in R^2 | Regress. coeffnt. | Partial F-value | Equation* properties |
|------------------------------|---------------|-------------|----------------|-------|-----------------|-------------------|-----------------|----------------------------------|
| Grade 3-4 Reading growth | 1 | TchAfl(4) | .288 | .083 | .083 | 0.63 | 6.05 | c = -23.0 n = 69 s = 11.0 |
| Grade 3-5 Reading growth | 1 | CAI | .406 | .165 | .165 | 0.269 | 12.60 | c = -10.66 n = 66 s = 8.84 |
| Grade 3-4 Mathematics growth | 1 | CAI | .390 | .152 | .152 | 0.213 | 11.42 | c = -7.95 n = 66 s = 6.78 |
| Grade 4-5 Mathematics growth | 1 | Matur(5) | .366 | .134 | .134 | 0.48 | 10.37 | c = -17.02 n = 69 s = 7.57 |
| | 1 | Matur(Avg) | .358 | .128 | .128 | 0.243 | 8.76 | c = -29.29 n = 62 s = 7.73 |
| Grade 3-5 Mathematics growth | 1 | Matur(3) | .434 | .188 | .188 | 0.57 | 7.08 | c = -25.45 n = 57 s = 6.85 |
| | 2 | CAI | .522 | .272 | .084 | 0.185 | 6.25 | n = 57 s = 6.85 |
| | 1 | CAI | .421 | .177 | .177 | 0.231 | 13.40 | c = -14.48 n = 63 s = 7.01 |
| | 2 | TchAfl(5) | .480 | .230 | .053 | 0.27 | 4.16 | n = 63 s = 7.01 |
| | 1 | CAI | .429 | .184 | .184 | 0.187 | 7.45 | c = -15.83 n = 62 s = 7.01 |
| | 2 | Confid(Avg) | .483 | .233 | .049 | 0.125 | 3.69 | n = 62 s = 7.01 |

*c = regression constant; n = sample size; s = residual root mean square; R^2 is the coefficient of determination, or the proportion of variance in the dependent variable explained by the regression equation.

TchAfl = Teacher Affiliation; Matur = Social Maturity; Confid = Social Confidence

Regressors with F-values exceeding 4.0 and 7.0 are significant at the $p < .05$ and $p < .01$ levels respectively.

during which growth was measured rather than at the beginning. Girls' third-grade social maturity was the single most powerful predictor of their growth in mathematics from third through fifth grade. Average social maturity scores and fifth grade social maturity scores also contributed to the prediction of girls' growth in mathematics achievement from fourth through fifth grade.

The results of regression analyses for students in the bottom and the top quartiles of the distribution are summarized in Tables 4.7 and 4.8, respectively. For students in the bottom quartile--the low achievers--both teacher affiliation and social confidence made moderate and consistent contributions to the explanations of variance in concurrent measures of reading achievement. For high-achieving students--those in the top quartile--no self-concept measure was significantly related to concurrent measures of reading or mathematics achievement or to growth in either subject. The average social maturity index, however, was a significant predictor of growth in mathematics from grade three to five for students in the top quartile.

Home Environment and Academic Achievement

Factor analysis and cluster analysis procedures were used to help reduce the large number of home environment variables (HEV). It should be noted that the use of factor analysis was purely heuristic, i.e., to provide information about the underlying structure of the data and the interrelationships of variables. Eleven plausible factors were identified and the variable with the highest correlation with each factor was chosen and used to "seed" a cluster analysis procedure in which each of the remaining variables was assigned to the cluster containing the seed variable with which it was maximally correlated. A variables-to-clusters correlation matrix was derived, and variables were reassigned to the cluster with which they were maximally correlated. The procedure was iterated up to five times, or until a complete pass through the data set resulted in no reassignment of variables.

Table 4.9 presents a summary of the variables contained in the nine most important clusters. The correlation of each cluster to the achievement cluster and to the growth cluster also is given. The data presented in Table 4.9 indicate that several variables were acceptable proxies for their clusters. For example, "family SES index" was a suitable proxy for the socioeconomic cluster, and "parental HMWRK" was a suitable proxy for the homework cluster. The family-wealth cluster, the opinions-about-school cluster, and the child's-extrascholastic-activities cluster contained no single variable which emerged as the best representative for the cluster. Since these clusters were small, and also because several of the variables exhibited significant and consistent partial correlations with achievement or growth, all were retained for the initial regression analyses. Several other clearly defined clusters were not retained, either because the clusters

Table 4.7

Regression of Reading and Mathematics Achievement and Growth on CAI and Self-Concept for Students in the Bottom Quartile*

| Dependent variable | Order entered | Regressor** | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation** properties |
|---|---------------|-------------|----------------|----------------|--------------------------|-------------------|-----------------|-----------------------|
| 3rd grade achievement reading | 1 | CAI* | .397 | .158 | .158 | 0.224 | 11.49 | c = 112.2 |
| | 2 | Sex* | .583 | .340 | .182 | 7.90 | 14.06 | n = 40 |
| | 3 | TchAfl(-2) | .633 | .401 | .061 | -0.20 | 3.65 | s = 6.05 |
| 4th grade achievement reading | 1 | Sex | .411 | .169 | .169 | 9.4 | 22.94 | c = 104.38 |
| | 2 | Confid(Avg) | .676 | .457 | .288 | 0.198 | 12.32 | n = 31 |
| | 3 | TchAfl(Avg) | .741 | .549 | .092 | -0.102 | 5.57 | s = 4.92 |
| 5th grade achievement reading | 1 | Confid(Avg) | .370 | .137 | .137 | 0.45 | 9.45 | c = 110.8 |
| | 2 | CAI | .390 | .152 | .152 | 0.227 | 7.08 | n = 41 |
| | 3 | Confid(5) | .490 | .240 | .088 | 0.24 | 3.84 | s = 9.8 |
| 5th grade achievement reading | 1 | Sex | .554 | .307 | .067 | 4.5 | 3.69 | c = 108.6 |
| | 2 | CAI | .371 | .138 | .138 | 0.18 | 2.96 | n = 42 |
| | 3 | Sex | .480 | .230 | .092 | 5.8 | 4.33 | s = 7.58 |
| Grade 3-5 Reading Growth-- no significant predictors entered with $F > 4.0$ | 1 | Confid(Avg) | .559 | .312 | .082 | 0.158 | 3.31 | c = 99.35 |
| | 2 | CAI | .371 | .138 | .138 | 0.18 | 2.96 | n = 32 |
| | 3 | Sex | .480 | .230 | .092 | 5.8 | 4.33 | s = 7.84 |
| 3rd grade achievement mathematics | 1 | CAI* | .573 | .328 | .328 | 0.117 | 11.49 | c = 114.3 |
| | 2 | Confid(3) | .611 | .373 | .045 | 0.134 | 4.45 | n = 41 |
| | 3 | Sex* | .650 | .423 | .050 | 1.8 | 3.24 | s = 3.10 |
| 4th grade achievement mathematics | 1 | Confid(Avg) | .651 | .424 | .424 | 0.107 | 16.08 | c = 108.9 |
| | 2 | CAI | .712 | .507 | .085 | 0.077 | 5.62 | n = 34 |
| | 3 | Sex | .735 | .540 | .033 | 1.38 | 2.19 | s = 2.62 |
| 5th grade achievement mathematics | 1 | Sex | .385 | .148 | .148 | 6.8 | 8.12 | c = 141.51 |
| | 2 | CAI | .524 | .275 | .275 | 0.304 | 15.92 | n = 41 |
| | 3 | Sex | .735 | .540 | .033 | 1.38 | 2.19 | s = 9.2 |
| Grade 3-5 growth mathematics | 1 | CAI | .465 | .216 | .216 | 0.183 | 11.83 | c = 122.8 |
| | 2 | Sex | .735 | .540 | .033 | 1.38 | 2.19 | n = 44 |
| | 3 | CAI | .524 | .275 | .275 | 0.304 | 15.92 | s = 7.09 |
| Grade 3-5 growth mathematics | 1 | CAI | .465 | .216 | .216 | 0.183 | 11.83 | c = -5.59 |
| | 2 | Sex | .735 | .540 | .033 | 1.38 | 2.19 | n = 45 |
| | 3 | CAI | .524 | .275 | .275 | 0.304 | 15.92 | s = 5.53 |

*Bottom Quartile refers to the 25 percent of students in the sample population who received the lowest scores on the specified achievement or growth index.

**CAI = cognitive aptitude index; sex is coded: male = 1; female = 2; n = sample size; c = regression constant; s = residual root mean square; R^2 is the proportion of variance explained by the regression equation.

TchAfl = Teacher Affiliation; Confid = Social Confidence

Regressors with F -value exceeding 2.9 and 4.3 are significant at the $p < .05$ and $p < .01$ levels, respectively.

Table 4.8

Regression of Reading and Mathematics Achievement and Growth on
CAI and Self-Concept for Students in the Top Quartile (*)

| Dependent variable | Order entered | Regressor** | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation properties** |
|-------------------------------|---------------|-------------|----------------|----------------|--------------------------|-------------------|-----------------|---------------------------------|
| 3rd grade reading achievement | 1 | CAI* | .421 | .177 | .177 | 0.261 | 9.06 | c = 137.9 n = 44 s = 6.64 |
| 5th grade reading achievement | 1 | CAI | .477 | .228 | .228 | 0.38 | 11.76 | c = 149.4 n = 42 s = 8.03 |
| Grade 3-5 reading growth | 1 | CAI | .339 | .115 | .155 | 0.148 | 4.97 | c = 16.47 n = 40 s = 5.91 |
| 4th grade mathematics growth | 1 | CAI | .550 | .302 | .302 | 0.414 | 29.38 | c = 139.6 n = 47 s = 5.81 |
| | 2 | Sex | .669 | .448 | .146 | -5.9 | 11.63 | |
| Grade 3-5 mathematics growth | 1 | Matur (Avg) | .311 | .097 | .097 | 0.12 | 4.00 | c = 5.12 n = 38 s = 3.61 |
| | 2 | CAI | .428 | .183 | .086 | 0.091 | 3.69 | |

No significant predictors entered with $F > 4.0$ for fourth grade reading achievement or for third and fifth grade mathematics achievement.

*Top Quartile refers to the 25 percent of students in the same population who received the highest scores on the specified achievement or growth index.

**CAI = cognitive aptitude index; sex is coded: male = 1, female = 2; n = sample size; c = regression constant; s = residual root mean square; R^2 is the proportion of variance explained by the regression equation.

Matur = Social Maturity

Regressors with F -values exceeding 3.3 and 5.0 are significant at the $p < .05$ and $p < .01$ levels, respectively.

Table 4.9

Summary of Results of Cluster Analysis of the Entire Variable Pool

| Variable/cluster name | R^2 for cluster | Variable/cluster name | R^2 for cluster |
|------------------------------|-------------------|---|-------------------|
| ACHIEVEMENT CLUSTER | | CHILD PROBLEMS CLUSTER | |
| Math achvmt grade 5 | .82 | Problems (total) | .86 |
| Read achvmt grade 5 | .80 | Parents to school to help solve problem | .48 |
| Math achvmt grade 4 | .79 | Pa called in to skul. | .41 |
| Math achvmt grade 3 | .78 | Adjustment problems | .38 |
| Read achvmt grade 3 | .77 | Ma called in to skul. | .36 |
| Read achvmt grade 4 | .71 | <u>R w/ achvmt cluster</u> | -.22 |
| Math achvmt grade 2 | .66 | <u>R w/ growth cluster</u> | -.11 |
| Read achvmt grade 2 | .63 | | |
| Aptitude index (CAI) | .62 | READING MATERIALS CLUSTER | |
| *How child "is doing" | .53 | Types of magazines | .82 |
| <u>R w/ achvmt cluster</u> | 1.00 | Types of read mat'ls. | .76 |
| <u>R w/ growth cluster</u> | .54 | # of magazines FST | .66 |
| GROWTH CLUSTER | | *FST profssnal. magzn. | .48 |
| Math growth gr. 3-5 | .52 | FST chldrn's. magzn. | .38 |
| Read growth gr. 3-5 | .52 | <u>FST news magazine</u> | .29 |
| Read growth gr. 3-4 | .49 | <u>R w/ achvmt cluster</u> | .16 |
| Math growth gr. 3-4 | .49 | <u>R w/ growth cluster</u> | .21 |
| <u>R w/ achvmt cluster</u> | .54 | | |
| <u>R w/ growth cluster</u> | 1.00 | FAMILY WEALTH CLUSTER | |
| SOCIOECONOMIC CLUSTER | | *Annual family income | .60 |
| Family SES index | .96 | *Market value of home | .54 |
| Father's SES index | .73 | <u>R w/ achvmt cluster</u> | .15 |
| *Pa years schooling | .63 | <u>R w/ growth cluster</u> | .14 |
| Pa post-h.s. educ. | .63 | OPINIONS ABOUT SCHOOL | |
| *Father's job status | .63 | *Strong academically | .63 |
| *Ma years schooling | .59 | *"Doing a good job" | .63 |
| Mother's SES index | .55 | <u>R w/ achvmt cluster</u> | .15 |
| Ma post-h.s. educ. | .53 | <u>R w/ growth cluster</u> | .22 |
| Mother's job status | .46 | CHILD'S EXTRASCHOLASTIC ACTIVITIES CLUSTER | |
| <u>R w/ achvmt cluster</u> | .29 | *Total extracurr. time | .75 |
| <u>R w/ growth cluster</u> | .32 | *# of Organized sports | .69 |
| HOMEWORK CLUSTER | | *# organized activ's. | .65 |
| Parental hmwrk. help | .89 | <u>R w/ achvmt cluster</u> | -.13 |
| TSD Pa help w/hmwrk. | .62 | <u>R w/ growth cluster</u> | -.14 |
| TSD kid does hmwrk. | .58 | | |
| TSD Ma help w/hmwrk. | .48 | | |
| <u>R w/ achvmt cluster</u> | -.26 | | |
| <u>R w/ growth cluster</u> | -.11 | | |

R = correlation; R^2 = coefficient of determination; TSD = time spent daily; FST = family subscribes to. Variables preceded with * were also included in some regressions. Variables given in boldface were selected as proxies for their respective clusters.

themselves were uncorrelated with the achievement cluster or the growth cluster, or because none of their component variables was consistently correlated with achievement or growth, or both. For example, six variables measuring the number and the relative age of the child's siblings formed a sharp cluster. None of the individual variables correlated significantly with achievement or growth, and the correlations of the cluster with the achievement cluster ($R = -.05$) and with the growth cluster ($R = .00$) was not statistically significant. Seven additional variables which were not members of a clearly defined cluster but which demonstrated significant and durable partial correlations with either achievement or growth also were retained. These seven variables included: (1) "child had problems with another student," (2) "number of child's religious activities," (3) "number of child's fine arts activities," (4) "father attended parent-teacher conference last year," (5) "child's TSD reading to self," (6) "TSD mother at work," and (7) "child dislike academic classes."

Unlike the SOS and achievement data, the variables measuring characteristics of the home environment of each student were not longitudinal in nature. Each parent was interviewed only once during the three-year period covered by the study--59 parents of third-grade students were interviewed in 1979-80, 57 parents of fourth-grade students were interviewed in 1980-81, and 82 parents of fifth-grade students were interviewed in 1981-82.

In general, HEV's were treated as if they were unrelated to either the year during which the interview was conducted or the source of the interview, i.e., gender and community of residence of the responding parent. However, it was noted that responses to three of the questions that survived the variable reduction process did vary substantially according to the age (grade) of the child at the time the interview was conducted. Mean "TSD mother at work" for mothers who were employed increased from 5.2 hours per day for mothers of third graders to 5.6 hours per day and 7.0 hours per day for mothers of fourth and fifth graders, respectively. Median "child's TSD reading to self" declined from 35 minutes per day for third graders to 26.5 minutes per day for fourth graders and 24 minutes per day for fifth graders. Median "TSD doing homework" increased from 18 to 37 to 38 minutes per day at the third-, fourth-, and fifth-grade levels.

Stepwise linear regression with forward selection was employed to examine the relationships between four sets of dependent variables--achievement and growth scores in reading and mathematics--and the various home environment variables that remained after application of partial correlation and cluster analysis procedures. It was assumed that home environment variables could affect a student's performance on a standardized achievement test but not vice versa. Thus, the only pathway of influence examined considered HEVs as potential determinants of the student's achievement and growth. Table 4.10 lists the HEVs selected for examination in the multiple regression analysis and the reason(s) for their selection.

Table 4.10

Summary of Home-Environment Variables Examined in Multiple Regression Analysis and Rationale for Including Them

| <u>Variable name</u> | <u>Reasons kept *</u> | <u>Variable name</u> | <u>Reasons kept *</u> |
|--------------------------------|-----------------------|---|-----------------------|
| <u>SOCIOECONOMIC VARIABLES</u> | | <u>READING RESOURCES VARIABLES</u> | |
| Pa yrs. schooling | 2, 3 | Read matl. variety | 1, 2 |
| Ma yrs. schooling | 2, 3 | FST professnl. mgzn. | 2 |
| Annual income | 1, 2, 3 | <u>PARENT/SCHOOL INTERACTION</u> | |
| Home market value | 2 | Pa to P.T. conf. | 1, 2 |
| Family SES index | 1, 2, 3 | <u>PARENT'S TIME-USE</u> | |
| Pa job status | 2 | TSD homework help | 1, 2, 3 |
| <u>CHILD'S TIME-USE</u> | | TSD ma at work | 2, 3 |
| TSD on homework | 2, 3 | <u>HOME EDUCATIONAL CLIMATE INDICES</u> | |
| TSD read to self | 1, 2 | # of siblings | 3 |
| Total TSD activs | 1 | # organized activ | 1 |
| # sports activs | 2 | Strong academics | 1, 2 |
| # church activs | 1, 2 | "School is good" | 1, 2 |
| # art/music activ | 2 | Child doing well | 2 |
| <u>PROBLEMS IN SCHOOL</u> | | | |
| Child-child prob. | 1 | | |
| "Hates academics" | 1, 2 | | |
| Total # of prob's | 1, 2 | | |

TSD = time spent daily; FST = family subscribes to.

- * Three separate criteria were used to select variables for examination in the regressions. Accordingly, variables with
- (1) were selected as proxies for clusters that were correlated ($R > .10$) with a cluster of achievement variables;
 - (2) demonstrated durable and statistically significant ($p < .05$) partial correlations to reading or math achievement or growth;
 - (3) were retained because they were identified in other research as being associated with measures of academic attainment.

In the first phase of the regression analysis, HEVs were regressed against four measures of student achievement in both reading and mathematics and three measures of student growth in each subject. An individual HEV was carried into the second phase of the analysis only if it made a significant contribution, for at least one group of students, to the ability of the variables in its cluster to predict at least two measures of achievement in reading and/or mathematics, and/or at least two measures of growth in reading or mathematics.

The first stage regressions were performed using the entire sample, boys and girls separately, and students in the top and bottom quartile separately. The results of the first stage regressions with top- and bottom-quartile students defied interpretation; no single HEV made a consistent and sensible contribution to the prediction of achievement or growth in reading or mathematics for students in either the top or bottom quartile. Therefore, no further examination of high- and low-quartile students was conducted.

At the second stage of the regression analysis, HEVs retained after the first stage regressions were combined in a single set of variables. In each of these regressions, one index of either achievement or growth was regressed on the remaining HEVs plus the CAI and gender indices of one of the three groups of students (total sample, boys, and girls). Descriptive statistics for each of the variables retained and the number of significant correlations they exhibited with achievement in reading and mathematics and growth in reading and mathematics are provided in Table 4.11. The number of significant correlations ($p = .05$) is shown with and without CAI partialled out. The variables retained included six socioeconomic variables, five variables describing the student's use of time, three variables relating to the student's problems in school, two variables related to reading resources in the home, one related to parent/school interaction, two related to the parent's use of time, and five related to educational climate variables in the home.

Six additional dependent variables were created at this stage by summing each student's scaled scores in reading and mathematics to create (1) a combined third- and fourth-grade score; (2) a combined fourth- and fifth-grade score; and (3) a combined third-, fourth- and fifth-grade score for each subject. Although these combined scores did not provide additional information, they were more stable than one-year scores and their inclusion aided in the identification of durable associations and in understanding the dynamics of associations between home environment characteristics and student achievement.

The independent variable "TSD Mother at Work" was modified slightly by substituting a value of zero for mothers who indicated they were housewives. This modification increased the sample size by over 50% and also facilitated comparison of the achievement and growth of children whose mothers were employed with those children whose mothers were not employed outside the home. With three exceptions ("how well the child is doing in school," "school has strong academics," and "TSD on home

Table 4.11

Descriptive Statistics for Selected Home Environment Variables and
Their Significant Correlations With Achievement and Growth

| Variables | Descriptive Statistics | | | | | Significant Correlations and Trends* | | | | |
|----------------------------------|------------------------|-------|------|------|-----|--------------------------------------|---------------|------------------|---------------|-------|
| | | | | | | Achievement | | Growth | | |
| | Mean | S.D. | Min. | Max. | N | Reading C P A | Math C P A | Reading C P A | Math C P A | |
| Socioeconomic | | | | | | | | | | |
| Pa yrs. schooling | 13.70 | 2.64 | 6 | 14 | 186 | 3 3 + | 3 1 + | 2 2 + | | |
| Ma yrs. schooling | 13.05 | 1.67 | 8 | 18 | 194 | 4 4 + | 3 3 + | 2 2 + | | |
| Annual income(1) | 2.86 | 0.90 | 1 | 5 | 188 | | 3 2 + | | | 1 1 + |
| Home market value | 58.24 | 20.13 | 16 | 135 | 166 | 3 2 + | 4 4 + | 1 0 + | | |
| Family SES index(2) | 39.76 | 11.67 | 9 | 66 | 197 | 4 4 + | 3 2 + | 2 2 + | | 2 2 + |
| Pa job status(3) | 5.30 | 2.00 | 0 | 9 | 187 | 4 4 + | 3 2 + | 2 2 + | | 2 1 + |
| Child's Time Use | | | | | | | | | | |
| TSD doing homework(4) | 0.50 | 0.45 | 0 | 2.0 | 194 | 3 2 - | 3 2 - | | | 1 0 - |
| TSD read to self | 0.54 | 0.58 | 0 | 4.0 | 186 | 4 4 + | 4 0 + | | | |
| * of sports actv's. | 0.39 | 0.67 | 0 | 4 | 196 | 3 3 - | 2 1 - | 1 1 - | | 2 1 - |
| * of church actv's. | 0.31 | 0.50 | 0 | 2 | 196 | 3 2 + | 4 2 + | 1 1 + | | |
| * of art/music actv's. | 0.19 | 0.51 | 0 | 3 | 196 | 2 3 + | 0 1 + | 1 1 + | | |
| Problems in School | | | | | | | | | | |
| Child-child prob. (5) | 9% | | | | 197 | 2 1 + | | | | |
| "Hates academics"(6) | 32% | | | | 197 | 2 0 - | 4 2 - | 1 0 + | | 1 0 - |
| Total # of prob's. | 1.10 | | 0 | 6 | 198 | 1 1 - | 3 3 - | | | |
| Reading Resources | | | | | | | | | | |
| Read Matl. variety | 3.9 | 1.7 | 0 | 7 | 197 | 1 1 + | 1 1 + | 2 2 / | | 2 2 + |
| FST professnl. mgzn. | 23.3% | | | | 197 | 2 2 + | 2 2 + | 2 2 + | | 2 1 + |
| Parent/School Interaction | | | | | | | | | | |
| Pa to P.T. Conf. | 58% | | | | 189 | 1 0 - | 3 3 - | | | 2 1 - |
| Parent's Time Use | | | | | | | | | | |
| TSD homework help | 0.26 | 0.31 | 0 | 1.5 | 175 | 3 1 - | 4 3 - | | | 1 0 - |
| TSD mother at work | 6.20 | 2.32 | 0.8 | 12.0 | 118 | 3 3 - | 1 2 - | | | 2 1 - |
| Home Educational Climate | | | | | | | | | | |
| # of siblings | 2.01 | 1.49 | 0 | 9 | 198 | | | | | |
| # organized activities | 1.40 | 1.09 | 0 | 4 | 196 | | | | | |
| #Strong academics | 49% | | | | 198 | 0 3 + | 0 1 + | 2 2 / | | 2 2 + |
| How well is (1) | 0.5% | | | | | | | | | |
| the school (2) | 3.0 | | | | | | | | | |
| doing its (3) | 34.2 | | | | 197 | 2 3 + | 2 2 + | | | 2 2 + |
| job? (8) (4) | 41.7 | | | | | | | | | |
| (5) | 20.1 | | | | | | | | | |
| How well is (1) | 0.0% | | | | | | | | | |
| the child (2) | 5.0 | | | | | | | | | |
| doing in (3) | 35.2 | | | | 197 | 4 3 + | 4 3 + | 2 2 - | | 2 2 - |
| school? (8) (4) | 39.7 | | | | | | | | | |
| (5) | 20.1 | | | | | | | | | |

*C = number of coefficients of correlation of the independent variable to four measures of achievement or three measures of growth that were significant at the $p < .05$ level.

P = number of coefficients of correlation of the same variables that were significant when CAI was partialled out.

A = nature of the relationship between the independent and dependent variables.

(+) positive association; (-) negative association; (/) association varied.

(1) Coded 1 = <\$10K, 2 = 10 K-20K, 3 = 20K-30K, 4 = 30K-40K, 5 = >40K

(2) Computed after Hollingshead (1975).

(3) Based on U.S. Bureau of the Census Occupational titles.

(4) TSD = time spent daily in hours

(5) Percent of parents indicating problems with another child in school

(6) Percent of parents indicating their child does not like academic work in school

(7) FST = Family subscribes to (means reported as percentages)

(8) Coded 1 = very poorly, 2 = below average, 3 = average, 4 = above average, 5 = extremely well.

workwork"), the HEVs were not influenced by the child's academic performance in any obvious way. Thus it is appropriate to consider them either as potential determinants of academic performance or as proxies for less quantifiable attributes of the home environment that are determinants of the child's scholastic performance.

Achievement and Growth in Reading and Mathematics--Total Sample

Tables 4.12-4.15 provide information concerning final equations for the regression of reading achievement and growth on CAI, gender, and selected home environment variables for the total sample. Separate analyses were conducted for third-, fourth- and fifth-grade achievement; for achievement when scores for grades 3-4, 4-5, and 3-5 were combined; and for growth in reading achievement from grades 3-4, grade 4-5, and grade 3-5.

Combining two-year and three-year achievement scores in the regressions tended to stabilize the output and was quite useful in identifying durable associations and trends. In general, strong one-year associations appeared even stronger, and weak and ephemeral associations disappeared when two- and three-year combined scores were examined. The ability of the CAI to predict one-year achievement scores varied considerably from year to year. However, examination of combined-year scores suggested that roughly 40% of the variance in children's third- through fifth-grade reading achievement in both reading and mathematics may be explained by using a measure of their academic aptitude obtained while they were in the second grade. The question, then, is how much of the remaining 60% of the variance in achievement scores can be accounted for by the home environment variables?

Two home environment variables made substantial and consistent contributions to the prediction of reading achievement. "TSD ma at work," through its negative association with achievement, explained 3% to 4% of the variance in third-, fourth-, and fifth-grade reading achievement scores, and nearly 7% of the variance in three-year combined reading achievement. Literal interpretation of the regression coefficients--not a recommended practice and offered here only to provide perspective--suggests that for each hour a child's mother worked each day, the child's reading achievement declined by approximately one point on a scale on which 10 points represents one year of growth for an average student. "Family SES index" was positively associated with achievement and explained from 1% to 5% of the variance in combined scores. The family SEX index was constructed using both parents' education and job-status levels, making literal interpretation of the regression coefficient impossible. For both "TSD ma at work" and "family SES index," the strength of the associations with achievement appear to increase slightly as the children progressed from third to fifth grade.

Table 4.12

Regression of Reading Achievement on CAI, Gender, and Selected Home Environment Variables for Total Sample

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties | |
|-----------------------|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|----------|
| 3rd grade achievement | (1) CAI | .676 | .457 | .457 | 0.63 | 128.14 | c = 76.3 | |
| | (2) TSD ma at work | .696 | .485 | .028 | -0.96 | 7.08 | n = 155 | |
| | (3) TSD on homework | .705 | .497 | .012 | -0.06 | 4.41 | s = 9.8 | |
| | (4) Sex | .713 | .509 | .012 | 3.1 | 3.69 | | |
| | (5) Family SES index | .720 | .519 | .010 | 0.13 | 3.35 | | |
| | (1) CAI | .676 | .47 | .457 | 0.54 | 96.83 | c = 75.9 | |
| | (2) Child doing well | .745 | .555 | .098 | 2.83 | 33.64 | n = 155 | |
| | | | | | | | s = 9.0 | |
| | 4th grade achievement | (1) CAI | .529 | .280 | .280 | 0.57 | 59.44 | c = 81.0 |
| | | (2) Sex | .571 | .326 | .046 | 4.5 | 4.08 | n = 163 |
| (3) Family SES index | | .606 | .367 | .041 | 0.19 | 4.16 | s = 12.9 | |
| (4) TSD ma at work | | .628 | .394 | .027 | -0.96 | 4.16 | | |
| (5) # art/music activ | | .643 | .413 | .019 | 4.7 | 4.67 | | |
| (6) Strong academics | | .653 | .427 | .014 | 4.1 | 4.75 | | |
| (7) TSD read to self | | .663 | .439 | .012 | 0.06 | 3.39 | | |
| (8) # sports activs | | .671 | .450 | .011 | -3.4 | 3.24 | | |
| (1) CAI | | .529 | .280 | .280 | 0.47 | 40.07 | c = 84.8 | |
| (2) Child doing well | | .651 | .424 | .144 | 4.17 | 39.82 | n = 163 | |
| | | | | | | s = 13.0 | | |
| 5th grade achievement | (1) CAI | .672 | .452 | .452 | 0.75 | 126.56 | c = 82.9 | |
| | (2) Family SES index | .706 | .499 | .047 | 0.31 | 12.11 | n = 151 | |
| | (3) TSD ma at work | .736 | .542 | .043 | 1.28 | 9.06 | s = 11.8 | |
| | (4) # sports activs | .750 | .563 | .021 | -4.6 | 8.18 | | |
| | (5) TSD on homework | .758 | .574 | .011 | -0.08 | 4.62 | | |
| | (6) # art/music activ | .764 | .584 | .010 | 3.8 | 3.50 | | |
| | (1) CAI | .672 | .452 | .452 | 0.67 | 93.32 | c = 74.8 | |
| | (2) Child doing well | .752 | .565 | .113 | 3.99 | 38.81 | n = 151 | |
| | | | | | | s = 11.9 | | |

*CAI = cognitive aptitude index; sex is coded: male = 1, female = 2; n = sample size; c = regression constant; s = residual root mean square; R² is the coefficient of determination or proportion of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribed to.

All reported coefficients are significant at the $p < .01$ level.

Table 4.13

Regression of Reading Achievement Combined Scores and Reading Growth on CAI, Gender, and Selected Home Environment Variables for Total Sample

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|---------------------------------------|--|----------------|----------------|--------------------------|-------------------|-----------------|--------------------------------|
| Grades 3-4 combined achievement | (1) CAI | .624 | .389 | .389 | 1.26 | 111.51 | c = 152.3 |
| | (2) TSD ma at work | .657 | .432 | .043 | -2.08 | 7.45 | n = 148 |
| | (3) Family SES index | .680 | .462 | .030 | 0.27 | 3.17 | s = 20.1 |
| | (4) Sex | .699 | .489 | .027 | 6.8 | 3.69 | |
| | (5) Strong academics | .712 | .507 | .018 | 7.3 | 5.29 | |
| | (6) # art/music activ | .720 | .518 | .011 | 6.0 | 3.13 | |
| | (7) # sports activs | .726 | .527 | .009 | -5.10 | 2.89 | |
| Grades 4-5 combined achievement | (1) CAI | .624 | .389 | .389 | 0.97 | 67.24 | c = 163.9 |
| | (2) Child doing well | .736 | .542 | .153 | 7.16 | 48.16 | n = 148 s = 19.4 |
| Grades 4-5 combined achievement | (1) CAI | .632 | .400 | .400 | 1.25 | 88.92 | c = 180.9 |
| | (2) Family SES index | .673 | .453 | .053 | 0.52 | 9.30 | n = 149 |
| | (3) TSD ma at work | .708 | .501 | .048 | -2.40 | 8.70 | s = 21.9 |
| | (4) # sports activs | .728 | .530 | .029 | -9.5 | 9.80 | |
| | (5) # art/music activ | .742 | .551 | .021 | 10.5 | 7.56 | |
| | (6) TSD read to self | .750 | .562 | .011 | 0.00 | 3.17 | |
| | (7) TSD on homework | .755 | .570 | .008 | -0.11 | 2.69 | |
| Grades 3-5 combined achievement | (1) CAI | .632 | .400 | .400 | 1.13 | 73.62 | c = 159.5 |
| | (2) Child doing well | .746 | .556 | .156 | 8.5 | 51.55 | n = 149 s = 21.9 |
| Grades 3-5 combined achievement | (1) CAI | .656 | .430 | .430 | 1.85 | 109.41 | c = 269.1 |
| | (2) TSD ma at work | .706 | .498 | .068 | -4.24 | 14.36 | n = 135 |
| | (3) Family SES index | .738 | .544 | .046 | 0.65 | 7.95 | s = 28.6 |
| | (4) # sports activs. | .753 | .567 | .023 | -11.6 | 8.18 | |
| | (5) # art/music activ | .766 | .586 | .019 | 13.4 | 7.78 | |
| | (6) TSD on homework | .775 | .600 | .014 | -0.19 | 4.54 | |
| Grade 3-4 growth | (1) CAI | .656 | .430 | .430 | 1.60 | 76.39 | c = 241.2 |
| | (2) Child doing well | .765 | .585 | .155 | 11.4 | 49.28 | n = 135 s = 28.6 |
| Grade 3-5 growth | (1) Family SES index | .176 | .031 | .031 | 0.17 | 4.84 | c = 3.3 n = 156 s = 11.3 |
| | (2) # sports activs. | .300 | .090 | .031 | -2.8 | 5.11 | c = 15.5 n = 142 |
| Grade 3-5 growth | (1) Family SES index | .243 | .059 | .059 | 0.14 | 2.86 | c = 15.5 |
| | (3) FST profesnl mgzn | .327 | .107 | .017 | 3.6 | 2.69 | n = 142 s = 10.0 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term);
s = residual root mean square; R² is the coefficient of determination, or proportion
of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribes to.

All reported coefficients are significant at the p < .05 level.

Table 4.14

Regression of Mathematics Achievement on CAI, Gender, and Selected Home Environment Variables for Total Sample

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|-----------------------|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd grade achievement | (1) CAI | .610 | .372 | .372 | 0.44 | 104.04 | c = 86.9 |
| | (2) TSD ma at work | .643 | .413 | .041 | -0.96 | 12.11 | n = 161 |
| | (3) Ma yrs. schooling | .663 | .440 | .027 | 1.08 | 7.34 | s = 8.0 |
| | (1) CAI | .610 | .372 | .372 | 0.35 | 62.73 | c = 96.1 |
| | (2) Child doing well | .699 | .489 | .117 | 2.35 | 36.12 | n = 161 |
| | | | | | | | s = 7.6 |
| 4th grade achievement | (1) CAI | .602 | .362 | .362 | 0.59 | 98.80 | c = 85.3 |
| | (2) TSD ma at work | .622 | .387 | .025 | -1.02 | 6.60 | n = 172 |
| | (3) Ma yrs. schooling | .636 | .405 | .018 | 1.15 | 4.75 | s = 11.5 |
| | (4) # sports activs | .648 | .420 | .015 | -3.1 | 4.24 | |
| | (1) CAI | .602 | .362 | .362 | 0.46 | 63.52 | c = 90.7 |
| | (2) Child doing well | .716 | .513 | .151 | 3.79 | 52.27 | n = 172 |
| | | | | | | s = 10.5 | |
| 5th grade achievement | (1) CAI | .657 | .431 | .431 | 0.68 | 116.86 | c = 97.2 |
| | (2) FST profesnl mgzn | .675 | .455 | .024 | 5.3 | 5.86 | n = 155 |
| | (3) TSD ma at work | .689 | .475 | .020 | -0.96 | 5.52 | s = 11.6 |
| | (1) CAI | .657 | .431 | .431 | 0.58 | 84.46 | c = 89.3 |
| | (2) Child doing well | .727 | .529 | .098 | 3.30 | 31.81 | n = 155 |
| | | | | | | | s = 10.9 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term); s = residual root mean square, R² is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribes to.

All reported coefficients are significant at the $p < .01$ level.

Table 4.15

Regression of Mathematics Achievement Combined Scores and Mathematics Growth on CAI, Gender, and Selected Home Environment Variables for Total Sample

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|-----------------------------|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd and 4th grades combined | (1) CAI | .636 | .404 | .404 | 1.03 | 110.46 | c = 175.7 |
| | (2) TSD ma at work | .669 | .447 | .043 | -2.16 | 10.76 | n = 155 |
| | (3) Ma yrs. schooling | .683 | .467 | .020 | 2.01 | 4.97 | s = 17.8 |
| | (4) # sports activa. | .692 | .479 | .012 | -4.4 | 3.31 | |
| | (1) CAI | .636 | .404 | .404 | 0.81 | 70.56 | c = 186.6 |
| | (2) Child doing well | .747 | .558 | .154 | 6.16 | 52.71 | n = 155 |
| | | | | | | | s = 16.3 |
| | | | | | | | |
| 4th and 5th grades combined | (1) CAI | .647 | .419 | .419 | 1.26 | 117.07 | c = 167.8 |
| | (2) TSD ma at work | .669 | .447 | .028 | -2.08 | 7.45 | n = 154 |
| | (3) Ma yrs. schooling | .686 | .470 | .023 | 2.6 | 6.20 | s = 21.2 |
| | (4) # sports activa. | .694 | .481 | .011 | -4.9 | 3.03 | |
| | (1) CAI | .647 | .419 | .419 | 1.01 | 79.57 | c = 183.2 |
| | (2) Child doing well | .746 | .556 | .137 | 7.1 | 46.92 | n = 154 |
| | | | | | | | s = 19.5 |
| | | | | | | | |
| Grades 3-5 combined | (1) CAI | .650 | .422 | .422 | 1.72 | 115.13 | c = 247.1 |
| | (2) TSD ma at work | .680 | .462 | .040 | -2.88 | 7.18 | n = 139 |
| | (3) Ma yrs. schooling | .704 | .496 | .034 | 3.8 | 6.45 | s = 27.5 |
| | (4) # sports activa. | .712 | .507 | .011 | -7.3 | 3.72 | |
| | (5) Strong academics | .718 | .516 | .009 | 7.3 | 2.56 | |
| | (1) CAI | .650 | .422 | .422 | 1.32 | 69.39 | c = 280.9 |
| | (2) Child doing well | .756 | .572 | .150 | 9.9 | 48.02 | n = 139 |
| | | | | | | | s = 25.5 |
| | | | | | | | |
| | | | | | | | |
| Grade 3-4 growth | (1) CAI | .295 | .087 | .087 | 0.17 | 16.24 | c = -8.1 |
| | (2) Strong academics | .358 | .129 | .042 | 2.8 | 6.15 | n = 157 |
| | (3) Family SES index | .379 | .144 | .015 | 0.03 | 2.53 | s = 7.4 |
| | (1) CAI | .295 | .087 | .087 | 0.11 | 6.45 | c = -3.4 |
| | (2) Child doing well | .367 | .135 | .048 | 1.14 | 8.70 | n = 157 |
| | | | | | | | s = 7.5 |
| | | | | | | | |
| Grade 4-5 growth | (1) CAI | .187 | .035 | .035 | 0.09 | 5.90 | c = 0.6 |
| | (2) Family SES index | .228 | .052 | .017 | -0.12 | 5.34 | n = 154 |
| | (3) Read matl. variety | .288 | .083 | .031 | 0.94 | 5.02 | s = 6.9 |
| | | | | | | | |
| Grade 3-5 growth | (1) CAI | .395 | .156 | .156 | 0.24 | 29.27 | c = -7.5 |
| | (2) Read matl. variety | .446 | .199 | .043 | 1.12 | 5.71 | n = 143 |
| | (3) Strong academics | .476 | .227 | .028 | 2.7 | 5.13 | s = 7.6 |
| | (1) CAI | .395 | .156 | .156 | 0.18 | 14.29 | c = -2.0 |
| | (2) Child doing well | .455 | .207 | .051 | 1.26 | 8.88 | n = 143 |
| | | | | | | | s = 7.6 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term); s = residual root mean square; R² is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribes to.
All reported coefficients are significant at the p < .05 level.

Two home environment variables made substantial and consistent contributions to the explanation of mathematics achievement. Again, "TSD ma at work," with a negative coefficient, was the most powerful predictor (other than CAI) of all students' achievement. It explained from 2% to 4% of the variance in single year and combined mathematics achievement scores, in addition to the 36% to 43% of the variance explained by the CAI. "Ma yrs. schooling," on the other hand, was positively associated with mathematics achievement. Each additional year of education obtained by a student's mother was associated with an increase of from 1.0 to 1.3 scaled score points in mathematics achievement each year.

Although asking a child's parents how their child is doing in school may not measure the quality of the educational climate in the child's home, it did add substantially ($R^2 = .15$) to the explanation of both reading and mathematics achievement, and provided some additional ability ($R^2 = .05$) to account for student growth in mathematics.

It should be noted, however, that it was difficult to predict growth scores in reading and mathematics using the variables included in the regression equations. Predictions of gain during fourth grade and during fifth grade were quite unstable and often yielded conflicting results. This was due, in part, to the phenomenon of regression to the mean. Students who registered large growth one year very frequently showed near zero or even negative growth the following year, and vice versa. Consequently, several HEVs that were positively associated with growth in one year were negatively associated with growth the next year. However, regressions predicting student growth across the third- through fifth-grade interval were reasonably stable. These two-year growth scores were approximately normally distributed around the instrument's standard two-year mean for growth of 20 scaled score points. Consequently, the regressions predicting two-year (grade 3-5) growth scores may be viewed with somewhat greater confidence than the regressions predicting one-year growth scores.

"Family SES index" was the only HEV to make a consistent, though small, contribution to the prediction of growth in reading ($R^2 = .03-.06$). Two HEVs, "strong academics" and "read MATL. variety," made small contributions ($R^2 = .03-.04$) to the prediction of growth in mathematics. Children whose parents felt that the school's greatest strength was the quality of its academic program registered approximately three points more gain in mathematics over the two-year period than did those whose parents listed some other strength of the school. The CAI explained from 4% to 16% of the variance in mathematics growth.

Two other HEVs measuring children's involvement in extra-scholastic activities made small but consistent ($R^2 = .03$), contributions to the prediction of achievement and growth. The number of sports activities was consistently negatively associated with reading achievement, math achievement, and reading growth; the number of art/music activities was positively associated with reading achievement. The regression

coefficients imply that reading achievement was depressed by from 3 to 5 scaled score points with each additional sports activity, and that mathematics achievement and reading growth were depressed by from 1 to 3 points. On the other hand, reading achievement was from 3 to 5 points higher among fourth- and fifth-grade students with each additional art, music, or dance activity. The latter relationship increased in strength as the children progressed to higher grade levels.

Achievement and Growth in Reading and Mathematics by Gender

The total sample was divided into boys and girls. The results of the analyses of boys are presented in Tables 4.16-4.18, with similar data for girls reported in Tables 4.19-4.21.

CAI was a useful predictor of both achievement and growth. Although its predictive capacity varied somewhat from year to year, regressions examining combined achievement scores show the CAI quite consistently explained from 45% to 50% of the variance in boys' reading achievement, from 40% to 48% of the variance in girls' reading achievement, 35% of the variance in boys' mathematics achievement, and from 50% to 53% of the variance in girls' mathematics achievement. The CAI did not contribute significantly to the prediction of boys' reading growth, but did account for 17% of boys' growth in mathematics, 17% of girls' growth in reading, and 18% of girls' growth in mathematics over the two-year period.

With the exception of the variable "child doing well," there was relatively little commonality in the results of the analysis of boys' and girls' achievement and growth. "Child doing well" contributed significantly to predictions of achievement in both reading and mathematics. The variable also made a small contribution to the prediction of boys' two-year growth in mathematics but did not contribute significantly to the prediction of boys' reading growth or girls' growth in either reading or mathematics.

The negative association between maternal employment ("TSD ma at work") and achievement in reading and in mathematics was pronounced for boys but was absent for girls. A literal interpretation of the regression coefficients, assuming linear association, suggested that boys' reading scaled scores were depressed from 1.3 to 2.0 points for each hour per week of maternal employment. Similarly, boys' mathematics scores were depressed from 1.0 to 1.5 points. Apart from "TSD ma at work," no HEV made a consistent contribution to the prediction of boys' reading achievement.

HEVs making consistent contributions to the prediction of boys' mathematics achievement included the family's annual income (positively correlated with achievement) and "hates academics" (negatively correlated with achievement). A literal interpretation of the regression coefficients suggests that each \$10,000 increase in family income was associated with an increase of from 1.5 to 4.1 scaled score points in mathematics.

Table 4.16

Regression of Reading and Mathematics Achievement on CAI and Selected Home
Environment Variables for Boys

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|-----------------------------------|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd grade reading | (1) CAI | .744 | .553 | .553 | 0.76 | 116.42 | c = 67.9 n = 90 |
| | (2) TSD ma at work | .767 | .588 | .035 | -1.28 | 7.40 | s = 10.3 |
| | (1) CAI | .744 | .553 | .553 | 0.66 | 88.54 | c = 62.8 n = 90 |
| | (2) Child doing well | .797 | .635 | .082 | 2.84 | 19.36 | s = 9.7 |
| 4th grade achievement reading | (1) CAI | .584 | .341 | .341 | 0.64 | 47.33 | c = 89.4 n = 92 |
| | (2) TSD ma at work | .611 | .373 | .032 | -1.32 | 4.62 | s = 13.8 |
| | (1) CAI | .584 | .341 | .341 | 0.52 | 33.76 | c = 77.8 n = 92 |
| | (2) Child doing well | .685 | .469 | .128 | 3.87 | 21.43 | s = 12.7 |
| 5th grade achievement reading | (1) CAI | .689 | .475 | .475 | 0.87 | 85.01 | c = 79.4 n = 88 |
| | (2) TSD ma at work | .728 | .530 | .055 | -2.00 | 9.92 | s = 13.9 |
| | (1) CAI | .689 | .475 | .475 | 0.77 | 63.04 | c = 66.6 n = 88 |
| | (2) Child doing well | .739 | .546 | .071 | 3.39 | 13.40 | s = 13.6 |
| 3rd grade achievement mathematics | (1) CAI | .581 | .337 | .337 | 0.41 | 45.83 | c = 100.0 n = 83 |
| | (2) TSD ma at work | .647 | .419 | .082 | -1.28 | 8.94 | s = 8.5 |
| | (3) Annual income | .670 | .449 | .030 | 2.5 | 5.95 | |
| | (4) "Hates academics" | .691 | .478 | .029 | -4.4 | 4.33 | |
| | (1) CAI | .581 | .337 | .337 | 0.33 | 25.20 | c = 197.5 n = 83 |
| | (2) Child doing well | .685 | .469 | .132 | 2.73 | 19.98 | s = 8.5 |
| 4th grade achievement mathematics | (1) CAI | .567 | .321 | .321 | 0.56 | 45.56 | c = 95.9 n = 88 |
| | (2) Annual income | .616 | .379 | .058 | 4.2 | 9.92 | s = 12.3 |
| | (3) TSD ma at work | .653 | .427 | .048 | -1.04 | 3.13 | |
| | (4) Problems (total) | .673 | .453 | .026 | -2.2 | 4.37 | |
| | (5) "Hates academics" | .691 | .478 | .025 | -6.0 | 3.84 | |
| | (1) CAI | .567 | .321 | .321 | 0.41 | 23.81 | c = 91.2 n = 88 |
| | (2) Child doing well | .719 | .517 | .196 | 4.71 | 34.57 | s = 11.6 |
| 5th grade achievement mathematics | (1) CAI | .622 | .387 | .387 | 0.61 | 64.64 | c = 97.9 n = 81 |
| | (2) "Hates academics" | .687 | .472 | .085 | -9.7 | 12.74 | s = 10.7 |
| | (3) Annual income | .734 | .539 | .067 | 4.2 | 12.39 | |
| | (4) TSD ma at work | .758 | .575 | .036 | -1.36 | 6.55 | |
| | (1) CAI | .622 | .387 | .387 | 0.48 | 35.76 | c = 93.9 n = 81 |
| | (2) Child doing well | .750 | .563 | .176 | 4.40 | 31.36 | s = 10.7 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term); s = residual root mean square; R² is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.
TSD = time spent daily in hours; FST = family subscribes to.
All reported coefficients are significant at the p < .01 level.

Table 4.17

Regression of Reading Achievement Combined Scores and Reading Growth on
CAI and Selected Home Environment Variables for Boys

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|---|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd and 4th grades combined achievement | (1) CAI | .704 | .496 | .496 | 1.4 | 87.05 | c = 155.9 |
| | (2) TSD ma at work | .736 | .542 | .046 | -2.88 | 8.12 | n = 84 |
| | (1) CAI | .704 | .496 | .496 | 1.17 | 65.93 | s = 21.1 |
| | (2) Child doing well | .791 | .626 | .130 | 7.0 | 28.20 | c = 143.0 |
| 4th and 5th grades combined achievement | (1) CAI | .669 | .448 | .448 | 1.49 | 72.76 | n = 84 |
| | (2) TSD ma at work | .707 | .500 | .052 | -3.44 | 8.58 | s = 24.6 |
| | (1) CAI | .669 | .448 | .448 | 1.28 | 55.80 | c = 145.2 |
| | (2) Child doing well | .744 | .554 | .106 | 7.2 | 19.62 | n = 85 |
| Grades 3-5 combined achievement | (1) CAI | .711 | .506 | .506 | 2.27 | 88.92 | s = 31.7 |
| | (2) TSD ma at work | .760 | .577 | .071 | -5.52 | 12.32 | c = 237.2 |
| | (1) CAI | .711 | .506 | .506 | 1.93 | 64.64 | n = 77 |
| | (2) Child doing well | .785 | .617 | .111 | 10.2 | 21.44 | s = 30.2 |
| Grade 3-5 growth | (1) Family SES index | .274 | .075 | .075 | 0.27 | 6.25 | c = 10.8 |
| | | | | | | | n = 79 |
| | | | | | | | s = 11.0 |

Grade 3-4 and grade 4-5 reading growth-- no significant predictors entered with $F > 4.0$.

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term); s = residual root mean square; R^2 is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribes to.

All reported coefficients are significant at the $p < .01$ level.

Table 4.18

Regression of Mathematics Achievement Combined Scores and Mathematics Growth On
CAI and Selected Home Environment Variables for Boys

| Dependent variable | Regressor and entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|---|------------------------------------|----------------|----------------|--------------------------|-------------------|-----------------|-------------------------------|
| 3rd and 4th grades combined achievement | (1) CAI | .588 | .346 | .346 | 0.96 | 46.79 | c = 194.9 |
| | (2) TSD ma at work | .660 | .436 | .090 | -3.04 | 9.61 | n = 79 |
| | (3) Annual income | .695 | .482 | .046 | 6.8 | 8.35 | s = 19.4 |
| | (4) "Hates academics" | .711 | .506 | .024 | -9.5 | 3.57 | |
| | (1) CAI | .588 | .346 | .346 | 0.71 | 24.70 | c = 190.2 |
| | (2) Child doing well | .694 | .539 | .193 | 7.6 | 31.81 | n = 79 s = 18.5 |
| 4th and 5th grades combined achievement | (1) CAI | .588 | .346 | .346 | 1.13 | 52.85 | c = 194.4 |
| | (2) TSD ma at work | .642 | .413 | .067 | -2.80 | 6.55 | n = 80 |
| | (3) Annual income | .694 | .481 | .068 | 8.9 | 13.40 | s = 21.6 |
| | (4) "Hates academics" | .729 | .532 | .051 | -15.8 | 8.12 | |
| | (1) CAI | .588 | .346 | .346 | 0.84 | 28.09 | c = 190.6 |
| | (2) Child doing well | .736 | .542 | .196 | 8.9 | 33.06 | n = 80 s = 21.1 |
| Grades 3-5 combined achievement | (1) CAI | .588 | .346 | .346 | 1.5 | 48.02 | c = 299.1 |
| | (2) TSD ma at work | .666 | .443 | .097 | -4.64 | 9.55 | n = 72 |
| | (3) Annual income | .708 | .501 | .058 | 11.8 | 11.02 | s = 28.4 |
| | (4) "Hates academics" | .743 | .552 | .051 | -20.6 | 7.56 | |
| | (1) CAI | .588 | .346 | .346 | 1.11 | 23.52 | c = 292.9 |
| | (2) Child doing well | .742 | .550 | .204 | 12.1 | 31.36 | n = 72 s = 28.0 |
| Grade 3-4 growth | (1) CAI | .293 | .086 | .086 | 0.16 | 7.56 | c = -3.2 n = 82 s = 8.3 |
| | (1) Child doing well | .316 | .100 | .100 | 1.58 | 9.18 | c = -0.0 |
| | (2) Family SES index | .377 | .142 | .042 | 0.14 | 3.84 | n = 82 s = 8.1 |
| Grade 4-5 growth | (1) CAI | .276 | .076 | .076 | 0.10 | 6.00 | c = -0.8 |
| | (2) "Hates academics" | .355 | .126 | .050 | -3.2 | 4.62 | n = 84 s = 6.1 |
| Grade 3-5 growth | (1) CAI | .412 | .170 | .170 | 0.17 | 7.95 | c = -6.1 |
| | (2) "Hates academics" | .504 | .254 | .084 | -5.2 | 7.95 | n = 79 |
| | (3) Family SES index | .561 | .315 | .061 | 0.19 | 6.20 | s = 7.6 |
| | (4) Child doing well | .591 | .349 | .034 | 1.06 | 3.80 | |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term);
s = residual root mean square; R² is the coefficient of determination, or proportion
of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribes to.
All reported coefficients are significant at the p < .05 level.

Table 4.19
Regression of Reading and Mathematics Achievement on CAI and Selected Home Environment Variables for Girls

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|-----------------------------------|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd grade achievement reading | (1) CAI | .641 | .411 | .411 | 0.55 | 55.95 | c = 78.7 |
| | (2) Pa yrs. schooling | .672 | .452 | .041 | 0.75 | 4.28 | n = 73 |
| | (3) Strong academics | .696 | .484 | .032 | 4.0 | 4.28 | s = 8.7 |
| | (1) CAI | .641 | .411 | .411 | 0.40 | 30.25 | c = 92.8 |
| | (2) Child doing well | .733 | .537 | .126 | 2.85 | 19.10 | n = 73 s = 8.2 |
| 4th grade achievement reading | (1) CAI | .577 | .333 | .333 | 0.66 | 45.83 | c = 82.5 |
| | (2) # of orgnzd activ | .670 | .449 | .116 | 4.2 | 9.86 | n = 76 |
| | (3) Strong academics | .711 | .506 | .057 | 7.2 | 8.07 | s = 11.5 |
| | (4) Prob w/ other kid | .729 | .531 | .025 | 8.5 | 3.72 | |
| | (1) CAI | .577 | .333 | .333 | 0.46 | 18.58 | c = 90.5 |
| | (2) Child doing well | .696 | .484 | .151 | 4.32 | 21.44 | n = 76 s = 11.9 |
| 5th grade achievement reading | (1) CAI | .734 | .539 | .539 | 0.82 | 77.44 | c = 77.4 |
| | (2) # of orgnzd activ | .763 | .582 | .043 | 3.3 | 6.76 | n = 68 |
| | | | | | | | s = 11.2 |
| | (1) CAI | .734 | .539 | .539 | 0.61 | 49.56 | c = 77.4 |
| | (2) Child doing well | .840 | .705 | .166 | 4.84 | 36.72 | n = 68 s = 9.4 |
| 3rd grade achievement mathematics | (1) CAI | .652 | .427 | .427 | 0.41 | 48.16 | c = 102.0 |
| | (2) Problems (total) | .675 | .455 | .028 | -1.27 | 3.80 | n = 77 |
| | (3) | | | | | | s = 7.1 |
| | (1) CAI | .653 | .427 | .427 | 0.32 | 33.52 | c = 96.9 |
| | (2) Child doing well | .769 | .592 | .165 | 2.62 | 30.03 | n = 77 s = 6.1 |
| 4th grade achievement mathematics | (1) CAI | .670 | .449 | .449 | 0.63 | 68.23 | c = 92.4 |
| | (2) Strong academics | .701 | .491 | .042 | 5.2 | 7.45 | n = 83 |
| | (3) Problems (total) | .723 | .523 | .032 | -1.9 | 5.34 | s = 9.2 |
| | (1) CAI | .670 | .449 | .449 | 0.47 | 41.09 | c = 92.2 |
| | (2) Child doing well | .771 | .594 | .145 | 3.4 | 28.73 | n = 83 s = 8.4 |
| 5th grade achievement mathematics | (1) CAI | .713 | .508 | .508 | 0.82 | 88.55 | c = 76.7 |
| | (2) Strong academics | .751 | .564 | .056 | 7.1 | 9.00 | n = 73 s = 10.5 |
| | (1) CAI | .713 | .508 | .508 | 0.61 | 45.97 | c = 84.1 |
| | (2) Child doing well | .780 | .609 | .101 | 3.5 | 17.98 | n = 73 s = 10.0 |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term);
s = residual root mean square; R² is the coefficient of determination, or proportion
of variance in the dependent variable explained by the regression equation.
All reported coefficients are significant at the p < .01 level.

Table 4.20

Regression of Reading Achievement Combined Scores and Reading Growth on
CAI and Selected Home Environment Variables for Girls

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|---|--|----------------|----------------|--------------------------|-------------------|-----------------|----------------------|
| 3rd and 4th grades combined achievement | (1) CAI | .630 | .397 | .397 | 1.18 | 58.83 | c = 171.1 |
| | (2) Strong academics | .706 | .498 | .101 | 12.5 | 9.92 | n = 70 |
| | (3) # of orgnzd activ | .746 | .556 | .058 | 5.8 | 7.62 | s = 17.5 |
| | (4) Prob w/ other kid | .762 | .581 | .025 | 13.1 | 3.80 | |
| | (1) CAI | .630 | .397 | .397 | 0.81 | 25.20 | c = 187.7 |
| | (2) Child doing well | .753 | .567 | .170 | 7.3 | 26.42 | n = 70 |
| | | | | | | | s = 17.5 |
| | | | | | | | |
| 4th and 5th grades combined achievement | (1) CAI | .691 | .477 | .477 | 1.5 | 69.72 | c = 156.3 |
| | (2) # of orgnzd activ | .753 | .567 | .090 | 7.7 | 9.30 | n = 68 |
| | (3) Strong academics | .767 | .589 | .022 | 9.6 | 3.53 | s = 21.2 |
| | (1) CAI | .691 | .477 | .477 | 1.04 | 34.81 | c = 154.5 |
| | (2) Child doing well | .815 | .664 | .187 | 9.7 | 36.12 | n = 68 |
| | | | | | | | s = 19.0 |
| Grades 3-5 combined achievement | (1) CAI | .691 | .478 | .478 | 2.04 | 70.06 | c = 242.1 |
| | (2) # of orgnzd activ | .752 | .566 | .088 | 9.5 | 7.84 | n = 63 |
| | (3) Strong academics | .776 | .602 | .036 | 16.1 | 5.38 | s = 27.6 |
| | (1) CAI | .691 | .478 | .478 | 1.52 | 32.60 | c = 265.8 |
| | (2) Child doing well | .816 | .666 | .188 | 12.9 | 33.76 | n = 63 |
| | | | | | | | s = 25.1 |
| Grade 3-5 growth | (1) CAI | .414 | .171 | .171 | 0.26 | 12.96 | c = -12.0 |
| | (2) # of orgnzd activ | .469 | .220 | .049 | 1.96 | 4.08 | n = 68 |
| | | | | | | | s = 8.5 |

Grade 3-4 and grade 4-5 reading growth-- no significant predictors entered with $F > 4.0$.

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term); s = residual root mean square; R² is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.

All reported coefficients are significant at the $p < .01$ level.

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Table 4.21

Regression of Mathematics Achievement Combined Scores and Mathematics Growth
on CAI and Selected Home Environment Variables for Girls

| Dependent variable | Regressor and order entered in equation* | Multiple corr. | R ² | Change in R ² | Regress. coeffnt. | Partial F-value | Equation* properties |
|---|--|----------------|----------------|--------------------------|-------------------|-----------------|------------------------------|
| 3rd and 4th grades combined achievement | (1) CAI | .706 | .499 | .499 | 1.13 | 76.74 | c = 182.5 |
| | (2) Strong academics | .740 | .547 | .048 | 9.0 | 8.07 | n = 75 |
| | (3) Problems (total) | .757 | .573 | .026 | -2.8 | 4.24 | s = 14.5 |
| 3rd and 4th grades combined achievement | (1) CAI | .706 | .499 | .499 | 0.80 | 46.79 | c = 187.5 |
| | (2) Child doing well | .816 | .666 | .167 | 6.1 | 36.00 | n = 75 s = 12.7 |
| 4th and 5th grades combined achievement | (1) CAI | .729 | .532 | .532 | 1.40 | 87.61 | c = 175.8 |
| | (2) Strong academics | .767 | .589 | .057 | 13.4 | 11.49 | n = 73 |
| | (3) Problems (total) | .782 | .612 | .023 | -3.3 | 4.08 | s = 17.5 |
| 4th and 5th grades combined achievement | (1) CAI | .729 | .532 | .532 | 1.04 | 53.00 | c = 177.5 |
| | (2) Child doing well | .823 | .678 | .146 | 7.4 | 31.70 | n = 73 s = 15.8 |
| Grades 3-5 combined achievement | (1) CAI | .731 | .535 | .535 | 1.91 | 81.00 | c = 263.4 |
| | (2) Strong academics | .772 | .596 | .061 | 18.4 | 10.89 | n = 66 |
| | (3) Problems (total) | .786 | .618 | .022 | -4.3 | 3.53 | s = 23.3 |
| Grades 3-5 combined achievement | (1) CAI | .731 | .535 | .535 | 1.32 | 47.65 | c = 274.2 |
| | (2) Child doing well | .844 | .713 | .178 | 10.8 | 38.81 | n = 66 s = 20.0 |
| Grade 3-4 growth | (1) CAI | .318 | .101 | .101 | 0.20 | 13.03 | c = -8.1 |
| | (2) Strong academics | .440 | .194 | .093 | 4.1 | 8.35 | n = 75 s = 6.5 |
| Grade 4-5 growth | (1) Prob w/other kid | .230 | .053 | .053 | 6.1 | 3.80 | c = 9.4 n = 70 s = 7.9 |
| Grade 3-5 growth | (1) CAI* | .424 | .180 | .180 | 0.21 | 11.49 | c = 0.0 |
| | (2) Strong academics | .540 | .292 | .112 | 4.7 | 9.67 | n = 64 |
| | (3) Prob w/other kid | .619 | .383 | .091 | 9.9 | 12.60 | s = 6.2 |
| | (4) Problems (total) | .647 | .418 | .035 | -1.3 | 3.53 | |

*CAI = cognitive aptitude index; n = sample size; c = regression constant (alpha term);

s = residual root mean square; R² is the coefficient of determination, or proportion of variance in the dependent variable explained by the regression equation.

TSD = time spent daily in hours; FST = family subscribes to.

All reported coefficients are significant at the $p < .05$ level.

Two HEVs made consistent contributions, positive in each case, to the prediction of girls' reading achievement. They included: (1) "# of ORGNZDACTIV"--the total number of sports, art/music, religious, organized club, and other activities in which the girls participated; and (2) "strong academics"--girls whose parents reported that the school's greatest asset was the strength of its academic program. The regression coefficient suggested that girls' reading scaled scores increased by 3 to 4 points with each additional activity they pursued, and by 4 to 7 points if their parents felt that the school had a strong academic program. There was no evidence that the strength of these relationships increased or decreased over time. "Strong academics" also made a modest positive contribution to the prediction of girls' mathematics achievement, while "problems (total)" exhibited a small negative association with girls' mathematics achievement.

Regression equations attempting to predict growth in reading and mathematics were rather unstable for both boys and girls. No single HEV accounted for more than 2% of the variance in either of the one-year reading growth scores for boys or for girls. Only one HEV, "family SES index," contributed to the prediction of boys' two-year growth in reading. "Family SES index" contributed positively to the prediction of boys' mathematics growth, while "hates academics" was negatively associated with boys' mathematics growth.

The number of organized activities in which the student participated was the only HEV which contributed significantly to prediction of girls' growth in reading. "Strong academics" made a relatively large contribution to the prediction of girls' growth in mathematics.

Discussion

It should be noted that while the data concerning student achievement and affective development used in these analyses were longitudinal in nature, i.e., gathered at the end of third, fourth, and fifth grade, the data concerning home environment variables were cross sectional. That is, only one parental interview was held, with approximately one-third of the parents being interviewed during each of the three years of the study. It is possible, therefore, that answers obtained from parents in the third year of the study could have been quite different had they been interviewed during the first year.

Cognitive Aptitude of the Student

Several studies, including Martin's (1982) examination of a portion of this same data base, have found moderately strong positive associations between levels of affective development and performance on measures of growth in the cognitive domain. An important finding of the present study was that the cognitive aptitude indices of students were

positively associated with all of the measures of cognitive development and with most of the measures of affective development, and that these associations were quite strong. In addition, the CAI was quite strongly correlated with many home environment measures that themselves were correlated with measures of either cognitive or affective development, or both. This made it necessary to eliminate statistically the confounding affects of these concomitant associations with CAI by permitting the cognitive aptitude index to enter all regressions. Inclusion of the CAI in the regressions had such a marked affect on the strength and durability of the associations that the results of this study cannot readily be compared to results of studies in which cognitive aptitude was not treated as a mediating influence.

When the effect of the CAI was partialled out, none of the seven self-concept indices examined in this study were found to be strong predictors of a student's reading or mathematics achievement, although the Social Maturity index obtained at the end of third grade did contribute to the prediction of one-year and two-year growth scores in mathematics. The results of this study provide no evidence that a positive self-concept is linked in causal fashion to a child's achievement in reading or mathematics. While the finding that a student's aptitude or ability explains a great deal of his or her academic performance may confirm the obvious, it is worth noting that the predictive capacity of the CAI increased slightly as the time between the dates of testing for aptitude and testing for academic performance increased.

The parents of the students who participated in this study had very accurate perceptions of their child's academic performance. The responses of parents to the question "how well is your child doing in school?" consistently accounted for a substantial amount of the variation in achievement scores. We do not claim that parental perceptions such as this influence a child's performance on an achievement test. More likely, parents' perceptions are influenced by the child's performance on tests, by report-card grades, and by the teacher's and the child's reports of incidents in the classroom and in the school. The importance of the parental perception is not as a determinant of academic performance, but, like the CAI, as an index for predicting future achievement levels and perhaps for evaluating the effectiveness of educational programs. For example, evidence indicating that an educational program produced achievement or growth in excess of that predicted by the CAI and parental perceptions would provide evidence that the program was successful.

Home Environment Variables and Student Achievement

Data concerning the home environment of students in this study were grouped into eight clusters, including family constellation, student's use of time, student's involvement in nonschool activities, parental time use, socioeconomic status, reading resources in the home, and

parent's involvement with school. None of the variables included in the family constellation cluster contributed significantly to the explanation of variance in achievement or growth scores for boys, girls, or all students. Recall, however, that the families in this study were quite homogeneous and that little variation existed in several of these variables.

Only two of the variables related to the student's use of time were found to be associated significantly with student achievement after the mediating influence of the CAI was removed. The amount of time students spent each day doing homework was weakly and negatively associated with their achievement in reading and mathematics, but it did not account for much of the variation in achievement or growth scores. The fact that children who spend more time doing homework do less well on achievement tests does not imply that doing homework is detrimental to academic performance. It is likely that students who learn more rapidly finish most of their work at school, and that only the slower learners find it necessary to do much school work at home. Viewed in this light, the negative relationship between time spent on homework and achievement is not surprising. The amount of time students spent each day reading to themselves was found to have a weak positive association with both reading and mathematics achievement and contributed modestly to the explanation of variance in girls' (but not boys') reading achievement scores.

In general, a student's involvement in cultural activities such as music lessons, dance lessons, etc. was significantly and positively associated with reading achievement for all students and for girls. Participation by girls in church-related activities was significantly and positively associated with their reading achievement and reading growth. The total number of activities in which girls participated also was significantly and positively associated with their achievement and with growth in reading. For boys, participation in sports activities was significantly and negatively associated with their achievement in reading and mathematics and with reading growth. It is not reasonable to conclude from these findings that participating in cultural activities or church-related activities improves a child's ability to read, or that involvement in sports activities is a detriment to the child's progress in reading or mathematics. More likely, these variables to some extent proxy for attitudes, expectations, and priorities for the use of time and monetary resources that define different types of home environments. Considered in this light, the results do not suggest a connection between cognitive development and the amount of time a child spends participating in various activities; rather, the link more likely is between the child's cognitive development and the types of activities chosen (presumably by the parent) to occupy the child's leisure time.

The amount of time parents spent reading to them was not significantly related to the reading achievement or growth of students. The amount of time spent helping students with homework increased from third to fifth grade. This made examination of the variable difficult,

since the regression analyses assumed static behavior over time for independent variables that were measured only once during the course of the study. Consequently, the population was divided into three groups according to the grade each child was in when his/her parent was interviewed. About 25% of the students received no help with homework from their parents. Examination of achievement profiles for the remaining 75% revealed that the association between achievement in both reading and mathematics and the amount of time parents spent helping with homework assumed a curvilinear shape, with a fairly steep positive slope up to about 8 or 10 minutes of homework help each day, then a general negative slope out to 120 minutes of help per day. The trend was quite consistent across all three grade levels. The results suggest that parents probably help their children for two different reasons. Small amounts of assistance may be provided to supplement the instruction the children receives in school; large amounts of parental help are probably remedial in nature and are intended to help the child who has fallen behind and who is not doing well in school. The fact that the association becomes increasingly negative probably is not so much an indication that their help is counterproductive as a sign that the child has fallen far behind and is in need of large doses of assistance from any source.

With regard to the employment of parents, nearly all of the fathers and male heads of household whose children were involved in this study held full-time jobs requiring at least 40 hours per week. It was not surprising, therefore, that the amount of time the father spent at work was not significantly correlated with any of the measures of achievement or growth. Maternal employment, on the other hand, was found to be related to both the achievement and growth of students. Information about employment was obtained for 193 of the 198 mothers and female guardians. Of these, 60 reported no employment outside the home, 15 said they worked only irregularly or infrequently, 108 worked a steady part-time or full-time job, and 10 worked at both a primary job and an occasional second job. Analysis of these data produced three findings: (1) Children whose mothers were employed did significantly worse on tests of reading and mathematics achievement than did children whose mothers were not employed. (2) The negative association between maternal employment and achievement increased as the number of hours per day of maternal employment increased. (3) The significant negative association between hours of maternal employment and both reading and mathematics achievement was pronounced for boys but only slight or nonexistent for girls. These findings are consistent with the conclusion of Milne, et. al. (1985) that there may be a tendency toward decrements in achievement, at least for the sons of working middle-class mothers, and that this trend appears to be most evident among children in the elementary school.

Examination of scatter plots of residuals revealed that the equation consistently overestimated achievement for children whose mothers were not employed at all. The regression line generally "fit" the data better when children whose mothers were not employed were excluded from the analysis. It was possible to compare other attributes

of the 133 households with working mothers to the 60 households with mothers who were not employed. Employed mothers were slightly, but not significantly, better educated and, despite the demands of their careers, spent more time helping their children with homework. On the other hand, children of employed mothers spent significantly more time watching television; spent less time reading to themselves (probably because there were fewer children's magazines and books in their home); were less apt to participate in organized activities, especially Sunday school/church, scouts, and youth groups; were more apt to have problems at school, especially with their academic progress; and were less apt to report that they liked their classes.

Family socioeconomic status was positively linked with all students' achievement in reading, with all students' and boys' growth in reading, and with boys' growth in mathematics. The strength of the association between family socioeconomic status and reading achievement appeared to grow as the students matured. The remaining socioeconomic indices--family income, market value of the home, ownership of the home, and paternal educational level and job status--did not account for variation in reading and mathematics achievement and growth scores. The family SES index ranked second only to the hours of mother's work in its contribution to the explanation of variation in reading achievement scores. It did not contribute to the explanation of variation in mathematics achievement scores, although the family SES index did make a significant contribution to the explanation of variation in boys' mathematics growth.

The design of this study made it possible to examine whether the linkage between SES and achievement goes beyond the coincidental positive associations of both SES and achievement with cognitive aptitude. The evidence suggests that it does, and that in comparison with other linkages between home environment characteristics and cognitive development, the association is quite robust. The fact that family SES index consistently accounted for from 4% to 5% of the variation in all student's reading achievement and growth scores and boys' mathematics growth scores (over and beyond that explained by the CAI) is indicative of the importance of family SES in explaining academic achievement in reading and mathematics.

It does not appear that income or wealth per se is the critical element in the home environments in which high-achieving children live. That is, it does not seem to be wealth or the counterments of wealth that influence or facilitate higher achievement; rather, it is the milieu in the homes of high-SES families who may (or may not) be wealthy--the attitude towards education, the expectations held for the child, and the provision of supplemental educational activities for the child. For example, the high-SES families in this study were more apt to subscribe to a newspaper, a children's magazine, a news magazine, and a professional journal than lower-SES families. They also owned more books and more children's books. Children of high-SES families watched less television, were responsible for more household chores, were more

apt to have attended pre-school and were more apt to attend church or Sunday school, belong to scouts, and take music or dance lessons than their low-SES classmates. While nearly all mothers attended parent-teacher conference, high-SES fathers were more likely to attend a parent-teacher conference than their low-SES counterparts. When given the opportunity to cite the greatest strengths and weaknesses of the school their child was attending, high-SES parents were more likely to specify academic areas, both as strengths and as weaknesses.

There was a moderately strong positive correlation between the family SES index and each of the reading resource indices, so it is not surprising that the various reading resource variables did not make a significant contribution to explanation of variance in reading achievement, reading growth, or mathematics achievement. The variety of reading material in the home was positively correlated with growth in mathematics and contributed significantly to the explanation of variation in mathematics growth scores.

Both boys and girls who experienced problems serious enough to warrant a parental visit to the school did less well in mathematics achievement than other students. The "total problems in school" variable contributed significantly to explanation of variation in both boys' and girls' mathematics achievement scores and girls' growth in mathematics. It is likely that the negative association between childrens' problems at school and their performance on achievement tests noted in this study is an early and rather mild manifestation of a problem that will become endemic to a sizeable number of lower achievers. Whether certain students cause problems in school because they are frustrated by their lack of academic progress, or whether their diminished academic progress is due to the fact they are busy causing trouble rather than paying attention, or whether their problems are due to external factors such as social immaturity or an unstable home situation, or whether all of these factors feed on and perpetuate one another cannot be determined from the data available here. The importance of this finding, however, is that the association is apparently observable as early as the third, fourth, and fifth grades.

The data available in this study made it possible to compare aspects of the home environment of children who experienced problems in school with those who did not. Children who experienced problems in school tended to live in homes where there was no adult male or where the adult male was not their natural father, or in homes where the adult female was not their natural mother. Their mothers were likely to work longer hours. They had attended more schools than their classmates. Their parents frequently reported that the student disliked the social aspects of school, an observation that is reinforced by the fact that their level of social confidence was significantly below that of their classmates for each of the three years.

Parental Opinions, Attitudes and Expectations

Parents were asked four questions: (1) What does your child like most about school? (2) What does your child like least about school? (3) What do you feel is the school's greatest strength? and (4) What do you feel is the school's greatest weakness? It was found that the boys whose parents said that their greatest dislike was a particular academic class (i.e., reading, math, science, or social studies) did significantly less well in reading achievement and demonstrated less growth in reading than their male classmates whose parents identified some other "greatest dislike." The variable "hates academics" made a significant contribution to the explanation of variation in boys' reading achievement and growth scores. Furthermore, the strength of the negative association between "hates academics" and reading achievement increased over the three-year period of the study. The increasing strength of the negative association between "hates academics" and boys' reading achievement and growth, together with the previously noted negative association between the variable "total problems" and both boys' and girls' mathematics achievement and growth scores, provides further evidence that frustration with scholastic experiences is evident as early as the fourth or fifth grade. It is not possible to tell from the available data whether the frustration is caused by poor academic performance or whether the poor performance is caused by lack of effort due to frustration. The important point, however, is that frustration with school apparently is observable at an early age and that it is clearly linked with depressed academic performance.

Conversely, the students (particularly girls) whose parents stated that the school's greatest strength was the quality of instruction in a particular subject or the academic program in general significantly outperformed their peers on the reading and mathematics achievement tests and demonstrated accelerated growth in mathematics. The implications of this finding are unclear. Why did some parents feel that a school was doing a good job in providing their children with a sound academic background, while others felt that the same school was doing a poor job? Does a school really do a better job with some children than with others as parents seem to suggest, or do children whose parents feel that the school is doing a good job try harder?

A number of home environment/achievement linkages identified in this research offer intriguing possibilities for additional study. Among them are the strong positive association between family socioeconomic status and children's achievement and growth in reading, and the strong negative association between maternal employment and boys' achievement in both reading and mathematics.

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SECTION V

STUDENT ACHIEVEMENT AND THE PERSONAL CHARACTERISTICS, INSTRUCTIONAL BEHAVIORS AND PROFESSIONAL BELIEFS OF THEIR TEACHERS

Conventional wisdom is that the teacher is a major determinant, if not the most important determinant, of student learning in schools. That is, most laymen and most professional educators believe that teachers do make a difference! Anyone with experience in schools is aware that parents and students "know" that some teachers are better (i.e., more effective) than others. In fact, one of the concerns expressed most frequently when merit pay for teachers is discussed is that of how to deal with parents whose child is assigned to a teacher who has not been identified as deserving of merit pay.

Research results also support the view that teachers do, indeed, make a difference. Summers and Wolfe (1975) found that junior high school students did better with teachers who graduated from higher-rated colleges and with mathematics teachers who were trained in the new math era. They also found that low-achieving elementary students did better with relatively less experienced teachers, and that high-achieving students did better with more experienced teachers. Murnane (1975) also found that teachers exert a critical impact on student learning.

Research on effective schools also supports the primacy of the classroom teacher in student achievement. These studies support the view that student achievement is higher in schools where there is a clear focus on academic goals, appropriately structured learning activities, a teaching method which focuses on the learning task to be accomplished, and an expectation of high student achievement (Armor et. al., 1976; Brookover et. al., 1979; Brophy, 1979; Good, 1979; Glenn, 1981; Venezky and Winfield, 1979). Effective classroom management also is characteristic of effective schools. Teachers select appropriate modes and techniques of instruction. They establish and enforce reasonable rules of conduct, provide an orderly atmosphere for learning, and maintain discipline. Students know what the teacher expects of them, receive timely feedback on their performance, and are praised for good performance (Armor et. al., 1976; Edmonds, 1979; Glenn, 1981; New York State Department of Education, 1976; Venezky and Winfield, 1979).

This section reports the results of an analysis of the relationships between student academic achievement in reading and mathematics and the personal characteristics, instructional behaviors, and attitudes and beliefs of their teachers. The data used in the analysis were drawn from the longitudinal study of school resource utilization and student performance in elementary schools described in Section I. The primary subjects were approximately 240 students in four elementary schools who were in grade 3 during the 1979-80 school year. These students subsequently were followed during their fourth- and

fifth-grade years (1980-81 and 1981-82). General characteristics of the students and teachers who comprised the sample were presented in Tables 1.4 and 1.5.

Methodology

The development of a data base suitable for examining the relationships between student achievement and teacher personal characteristics, instructional behaviors, and professional attitudes and beliefs involved three procedures. First, it was necessary to define a population of teachers and students for whom an association between teacher attributes (the independent variables) and student achievement in reading and mathematics (the dependent variables) could reasonably be expected. Second, it was necessary to reduce the extensive amount of data on personal characteristics of teachers to a small set of variables exhibiting minimal collinearity. Third, the extensive data on teacher attitudes and beliefs had to be reduced to a small set of noncollinear variables.

Definition of the Population

The selection of teachers and students for these analyses was based in part on records of classroom observations of students in reading and mathematics classes. The determination of the particular teacher to whom a student's achievement in these subjects could be attributed was complicated by the flexible grouping practices used in some schools, and by the use of special teachers in areas such as remedial reading or learning disabilities. In the course of a school year, some students were observed with two or three different regular classroom teachers for reading or mathematics, while other students were observed with a regular teacher most of the time but occasionally with a special teacher. Still other students were observed with a special teacher throughout the year.

Students who were observed with more than one regular teacher for reading or mathematics were eliminated from the data base since it was impossible to assign their performance to a single teacher, and their performance could not be appropriately divided among two or more teachers on other than an arbitrary basis. Students who spent all of their time with a special teacher also were eliminated from the data base because they were given lower priority in classroom observations and, consequently, data for them were not complete. Students who were generally observed with a classroom teacher but on occasion observed with a special teacher for reading or mathematics were included on the assumption that the regular teacher initiated and followed up on this service for the child. That is, the professional judgment of the regular teacher was a major factor in the student receiving and benefiting from special services. In addition, it was decided to retain only teachers for whom there were six or more student observations in the subject under study. After

these decision rules were applied, 13 reading teachers were retained in year one and year two and 14 were retained in year three. Likewise, 10 mathematics teachers were retained in year one and year two and 17 were retained in year three. Teacher-student dyads in reading were 202, 171, and 183 in the first, second and third years of the study, respectively. In mathematics, there were 198 teacher-student dyads in year one, 156 in year two and 150 in year three.

Table 5.1 provides information about the number of teacher-student dyads that could be identified for each regular classroom teacher for reading and for mathematics in each year of the study; Table 5.2 indicates the percent of the total student population represented by these teacher-student dyads. The students in teacher-student dyads included a relatively high percentage of the total student population in three of the four schools. As noted in Section I, School 3 used extensive regrouping within a multigraded instructional setting. Consequently, in only one instance (reading in year three) did the percentage of students in teacher-student dyads represent more than 50% of the total student population, and in one case (mathematics in year two) the number of students in teacher-student dyads was only 13% of the total student population.

Tables 5.3 and 5.4 provide information on reading achievement for the total population and for the teacher-student dyads used in this study. The data indicate that the level of achievement in the sample of teacher-student dyads is generally representative of the total population in each grade. A special situation should be noted in School 1, year two for reading. A teacher was replaced at the end of the first semester, requiring that the students in that class be dropped from the data base. The grouping practices in the school apparently were such that when these students were omitted, a less representative sample of the student body resulted, since the achievement for the sample of teacher-student dyads is rather discrepant from that obtained in year one and year three.

The unit of statistical analysis for this aspect of the study was the student. However, the analysis was constrained by the relatively small number of teachers who could be identified for teacher-student dyads for each subject in each year. This made it necessary to reduce the extensive pool of variables describing teacher personnel characteristics, instructional behavior, and professional attitudes and beliefs before regression models could be tested.

Selection of Teacher Demographic Variables

Since some of the teachers were involved in the study during more than one year, a total of 38 teachers are represented in the teacher-student dyads described in the preceding section. Information on 35 variables concerning their personal, educational, and professional background and activities were obtained from each of the 38 teachers.

Table 5.1

NUMBER OF TEACHER-STUDENT DYADS FOR EACH REGULAR CLASSROOM TEACHER
BY YEAR IN READING AND MATHEMATICS

| READING | | | | | | |
|---------|----------------------|----------|----------------------|----------|----------------------|----------|
| School | Year 1 Teacher ID | N | Year 2 Teacher ID | N | Year 3 Teacher ID | N |
| 1 | 11 | 17 | 18 | 30 | 56 | 16 |
| | 12 | 32 | 19 | 19 | 57 | 21 |
| | 13 | 18 | | | 58 | 21 |
| | Total | <u>3</u> | <u>67</u> | <u>2</u> | <u>49</u> | <u>4</u> |
| 2 | 21 | 29 | 20 | 23 | 61 | 17 |
| | 22 | 27 | 27 | 25 | 64 | 24 |
| | Total | <u>2</u> | <u>56</u> | <u>2</u> | <u>48</u> | <u>2</u> |
| 3 | 31 | 16 | 73 | 5 | 74 | 6 |
| | 32 | 9 | 76 | 9 | 76 | 2 |
| | 33 | 17 | 96 | 7 | 90 | 10 |
| | | | | | 92 | 2 |
| | | | | | 94 | 7 |
| | Total | <u>3</u> | <u>42</u> | <u>3</u> | <u>21</u> | <u>6</u> |
| 4 | 40 | 21 | 40 | 7 | 87 | 19 |
| | 41 | 15 | 41 | 5 | 88 | 21 |
| | 42 | 6 | 42 | 13 | 97 | 19 |
| | 43 | 9 | 43 | 11 | | |
| | 44 | 1 | 44 | 21 | | |
| | Total | <u>5</u> | <u>52</u> | <u>6</u> | <u>60</u> | <u>3</u> |

| MATHEMATICS | | | | | | |
|-------------|----------------------|-----------|----------------------|----------|----------------------|-----------|
| School | Year 1 Teacher ID | N | Year 2 Teacher ID | N | Year 3 Teacher ID | N |
| 1 | 11 | 26 | 18 | 31 | 56 | 22 |
| | 12 | 25 | 19 | 36 | 57 | 11 |
| | 13 | 15 | | | 58 | 16 |
| | Total | <u>3</u> | <u>66</u> | <u>2</u> | <u>67</u> | <u>4</u> |
| 2 | 21 | 31 | 20 | 24 | 61 | 22 |
| | 22 | 25 | 27 | 4 | 63 | 7 |
| | Total | <u>2</u> | <u>56</u> | <u>3</u> | <u>32</u> | <u>3</u> |
| 3 | 31 | 2 | 73 | 5 | 74 | 1 |
| | 33 | 18 | 76 | 1 | 76 | 5 |
| | | | | | 91 | 4 |
| | | | | | 92 | 2 |
| | | | | | 94 | 4 |
| Total | <u>2</u> | <u>20</u> | <u>2</u> | <u>6</u> | <u>6</u> | <u>20</u> |
| 4 | 40 | 23 | 43 | 19 | 86 | 9 |
| | 41 | 28 | 44 | 16 | 87 | 15 |
| | 42 | 17 | 46 | 22 | 88 | 3 |
| | | | | | 97 | 3 |
| | Total | <u>3</u> | <u>68</u> | <u>3</u> | <u>57</u> | <u>4</u> |

Table 5.2

PERCENT OF THE TOTAL STUDENT POPULATION REPRESENTED
BY THE TEACHER-STUDENT DYADS

| Year | School | Total number of students observed | Number of teacher-student dyads with complete data | Percent of teacher-student dyads |
|-------------|--------|---|--|--|
| READING | | | | |
| 1 | 1 | 75 | 64 | 85 |
| | 2 | 57 | 51 | 89 |
| | 3 | 43 | 37 | 86 |
| | 4 | <u>71</u> | <u>50</u> | 70 |
| | | 246 | 202 | |
| 2 | 1 | 79 | 48 | 61 |
| | 2 | 55 | 46 | 84 |
| | 3 | 47 | 19 | 40 |
| | 4 | <u>71</u> | <u>58</u> | 82 |
| | | 252 | 171 | |
| 3 | 1 | 58 | 57 | 98 |
| | 2 | 50 | 41 | 82 |
| | 3 | 44 | 28 | 64 |
| | 4 | <u>59</u> | <u>57</u> | 97 |
| | | 211 | 183 | |
| MATHEMATICS | | | | |
| 1 | 1 | 73 | 63 | 86 |
| | 2 | 56 | 52 | 93 |
| | 3 | 43 | 17 | 39 |
| | 4 | <u>71</u> | <u>66</u> | 93 |
| | | 243 | 198 | |
| 2 | 1 | 79 | 64 | 81 |
| | 2 | 54 | 31 | 57 |
| | 3 | 47 | 6 | 13 |
| | 4 | <u>71</u> | <u>55</u> | 77 |
| | | 251 | 156 | |
| 3 | 1 | 61 | 58 | 95 |
| | 2 | 49 | 45 | 92 |
| | 3 | 44 | 20 | 45 |
| | 4 | <u>61</u> | <u>27</u> | 44 |
| | | 215 | 150 | |

Table 5.3
 READING ACHIEVEMENT BY SCHOOL FOR THE TOTAL STUDENT
 POPULATION AND FOR TEACHER-STUDENT DYADS

| <u>Total Population</u> | | | | | <u>Teacher-Student Dyads</u> | | | | |
|-------------------------|-----|-------|------|---------|------------------------------|-----|-------|------|---------|
| Scaled Score | | | | | Scaled Score | | | | |
| | N | Mean | S.D. | Range | | N | Mean | S.D. | Range |
| <u>Year 1</u> | | | | | <u>Year 1</u> | | | | |
| School 1 | 72 | 153.0 | 17.1 | 119-198 | School 1 | 64 | 154.0 | 17.3 | 119-198 |
| School 2 | 52 | 143.4 | 15.1 | 116-172 | School 2 | 51 | 141.2 | 15.1 | 116-170 |
| School 3 | 38 | 154.2 | 13.1 | 134-181 | School 3 | 37 | 154.0 | 13.3 | 134-181 |
| School 4 | 69 | 152.8 | 10.8 | 133-179 | School 4 | 50 | 151.5 | 10.0 | 133-176 |
| Totals | 231 | 151.0 | 14.9 | 116-198 | Totals | 191 | 150.7 | 15.2 | 116-198 |
| <u>Year 2</u> | | | | | <u>Year 2</u> | | | | |
| School 1 | 75 | 162.7 | 18.9 | 124-221 | School 1 | 48 | 152.5 | 12.7 | 124-172 |
| School 2 | 52 | 154.7 | 19.6 | 123-197 | School 2 | 46 | 157.0 | 18.7 | 123-197 |
| School 3 | 45 | 167.7 | 19.7 | 119-215 | School 3 | 19 | 172.6 | 22.1 | 143-215 |
| School 4 | 69 | 158.6 | 20.3 | 107-215 | School 4 | 58 | 158.8 | 21.4 | 107-215 |
| Totals | 241 | 160.7 | 20.0 | 107-221 | Totals | 171 | 158.1 | 19.4 | 107-215 |
| <u>Year 3</u> | | | | | <u>Year 3</u> | | | | |
| School 1 | 57 | 172.7 | 16.5 | 143-215 | School 1 | 57 | 172.7 | 16.5 | 143-115 |
| School 2 | 49 | 164.8 | 20.2 | 131-211 | School 2 | 41 | 166.2 | 19.7 | 133-211 |
| School 3 | 44 | 175.7 | 16.9 | 146-215 | School 3 | 28 | 174.9 | 17.5 | 146-212 |
| School 4 | 55 | 174.9 | 17.3 | 127-221 | School 4 | 57 | 174.9 | 17.0 | 127-221 |
| Totals | 205 | 172.0 | 18.1 | 127-221 | Totals | 183 | 172.3 | 17.8 | 127-221 |

Table 5.4

**MATHEMATICS ACHIEVEMENT BY SCHOOL FOR THE TOTAL STUDENT
POPULATION AND FOR TEACHER-STUDENT DYADS**

| <u>Total Population</u> | | | | | <u>Teacher-Student Dyads</u> | | | | |
|-------------------------|------------|--------------|-------------|----------------|------------------------------|------------|--------------|-------------|----------------|
| Scaled Score | | | | | Scaled Score | | | | |
| N | Mean | S.D. | Range | | N | Mean | S.D. | Range | |
| <u>Year 1</u> | | | | | <u>Year 1</u> | | | | |
| School 1 | 72 | 149.3 | 13.2 | 119-180 | School 1 | 63 | 149.4 | 13.1 | 119-180 |
| School 2 | 52 | 144.1 | 13.2 | 114-176 | School 2 | 52 | 144.1 | 13.2 | 114-176 |
| School 3 | 38 | 147.9 | 9.7 | 134-183 | School 3 | 17 | 142.3 | 7. | 134-167 |
| School 4 | 69 | 147.4 | 10.2 | 122-173 | School 4 | 66 | 146.8 | 9.6 | 122-168 |
| Totals | 231 | 147.3 | 11.9 | 114-183 | Totals | 198 | 146.5 | 11.8 | 114-180 |
| <u>Year 2</u> | | | | | <u>Year 2</u> | | | | |
| School 1 | 75 | 166.3 | 14.6 | 128-203 | School 1 | 64 | 170.3 | 12.2 | 147-203 |
| School 2 | 52 | 158.0 | 16.0 | 124-192 | School 2 | 31 | 156.8 | 15.5 | 124-188 |
| School 3 | 45 | 163.2 | 14.5 | 129-203 | School 3 | 6 | 163.3 | 12.0 | 152-184 |
| School 4 | 69 | 161.1 | 16.1 | 124-203 | School 4 | 55 | 158.2 | 16.4 | 124-203 |
| Totals | 241 | 162.3 | 15.6 | 124-203 | Totals | 174 | 162.4 | 15.7 | 124-203 |
| <u>Year 3</u> | | | | | <u>Year 3</u> | | | | |
| School 1 | 60 | 174.6 | 16.1 | 133-208 | School 1 | 58 | 174.9 | 16.2 | 133-208 |
| School 2 | 49 | 167.0 | 18.1 | 131-206 | School 2 | 45 | 166.9 | 19.4 | 131-206 |
| School 3 | 44 | 173.7 | 16.3 | 142-220 | School 3 | 20 | 175.6 | 19.9 | 142-220 |
| School 4 | 57 | 171.8 | 15.3 | 145-206 | School 4 | 27 | 165.1 | 15.6 | 145-206 |
| Totals | 210 | 171.9 | 16.7 | 131-206 | Totals | 150 | 170.8 | 18.0 | 131-220 |

It was possible to eliminate 25 of the 35 variables after examining the raw data and descriptive statistics. Some of them displayed little or no variability, and data were missing for others. Some variables were well proxied by another variable and these were eliminated. The 10 variables retained either had been shown in previous research to be of potential importance in explaining student achievement or were of particular interest in this study. The variables retained for further analysis were age, sex, graduate-degree status, number of graduate credits earned in the past 24 months, current enrollment in a graduate-degree program, membership in professional organizations, number of professional magazines and journals read regularly, years of teaching experience, method of placement at the grade level, and number of non-credit courses taken in the past three years.

Selection of Teacher Behavior and Belief Variables

Self-report data about instructional behaviors and professional beliefs were obtained from 34 of the 38 teachers using the questionnaire described in Section I. The questionnaire included 17 multiple-choice items dealing with preferences for teaching students of particular socioeconomic and ability levels as well as ratings of the ability and effort of the students they taught. Other items covered instructional practices such as pre-testing, homework, use of competition, grading and discipline. Teachers' professional beliefs about a wide range of areas, including the purpose of schooling, the roles of teachers and students, instructional techniques, and classroom management, were probed using 41 items and a five-point Likert scale response set.

There were three general stages in the process of reducing the number of variables to be retained for additional analysis: (1) factor analysis to indicate whether the data were potentially amenable to cluster analysis; (2) cluster analysis to select representative variables for preliminary regressions; and (3) preliminary regressions on student achievement in reading and mathematics of the selected personal characteristics and the representative behaviors and beliefs.

Initially, a factor analysis was performed to obtain a gross indication of the relationships among variables and to estimate whether the data were amenable to cluster analysis. The factor analysis provided support for using a cluster analysis procedure as well as identifying certain "seed" variables for the cluster analysis.

The subsequent oblique principal component cluster analysis identified 13 variable clusters, each containing from three to eight variables. Each cluster was examined and the clusters were judged to be reasonable from a substantive point of view, although there were some instances where individual variables had no intuitively obvious relationship to other variables in the cluster. For 11 of the 13 clusters, a single variable was selected to represent the cluster because that variable had the highest R^2 with its own cluster and a relatively low R^2 with the cluster with which it had its next highest

relationship. In several clusters, two or more variables had very similar R^2 values. In these situations, the nature of the question and the variability exhibited in the response set were considered before making the final choice. In two instances (Cluster 8 and Cluster 11), two variables were retained to represent the cluster because it was not evident which variable best captured the content of the cluster. The results of the cluster analysis procedure and the variables retained for further analysis are shown in Table 5.5. Six of the variables retained for further analysis (Q14, 20, 21, 24, 27 and 67) dealt with teachers' attitudes toward students and instructional practices; the remaining nine questions dealt with teachers' attitudes and beliefs.

Regression Analyses

A preliminary series of correlation and regression analyses were performed, and five additional variables were eliminated. Age and years of teaching experience were highly correlated (.7 to .9) and, since years of teaching experience was deemed more relevant, it was retained. Further examination revealed that most teachers belonged to only one union or educational association and this variable was dropped. The other remaining variables were similarly re-examined and it was decided to retain sex, graduate-degree status, graduate credits earned in the last 24 months, and number of professional magazine and journals, the latter two as proxies for professional development activities. In addition, a measure of general satisfaction with teaching obtained from the Furdue Teacher Opinionnaire was added to the data base.

Regression analyses then were employed to ascertain relationships between student academic achievement in reading and mathematics and the selected variables related to teachers' personal characteristics, attitudes, beliefs and behaviors described in the preceding sections. Standardized student achievement scores in reading and mathematics were regressed on each set of variables, both separately and in combination. The following regression models were applied for both reading and mathematics achievement scores: (1) teacher personal characteristics; (2) teacher attitudes, beliefs and behaviors; (3) teacher personal characteristics followed by teacher attitudes, beliefs and behaviors; (4) teacher attitudes, beliefs and behaviors followed by teacher personal characteristics; (5) teacher personal characteristics followed by teacher attitudes, beliefs and behaviors entered step-wise; (6) teacher attitudes, beliefs and behaviors followed by teacher personal characteristics entered step-wise; (7) reading scale score with the student's previous year's scaled score as a base variable (to control for previous academic achievement), followed by teacher personal characteristics and teacher attitudes, beliefs and behaviors. Separate regressions were computed for scaled scores in reading and mathematics obtained at the end of the fourth-grade and fifth-grade years.

Teacher personal characteristics alone produced R^2 values of from .22 to .48 with reading and mathematics scaled scores. The teacher attitude, belief and behavior variables alone produced R^2 ranging from

Table 5.5

TEACHER BEHAVIOR AND BELIEF VARIABLES CHOSEN TO REPRESENT CLUSTERS

| Cluster | Number of members | Variable* | Representative Variable | |
|---------|-------------------|-----------|-----------------------------|--|
| | | | R ² with cluster | R ² with next highest cluster |
| 1 | 5 | Q 14 | .77 | .26 |
| 2 | 6 | Q 41 | .64 | .08 |
| 3 | 4 | Q 42 | .68 | .13 |
| 4 | 8 | Q 67 | .61 | .11 |
| 5 | 4 | Q 45 | .68 | .17 |
| 6 | 3 | Q 30 | .61 | .08 |
| 7 | 4 | Q 55 | .69 | .17 |
| 8 | 4 | Q 37 | .56 | .11 |
| | | Q 20 | .60 | .06 |
| 9 | 5 | Q 39 | .70 | .23 |
| 10 | 6 | Q 47 | .44 | .03 |
| 11 | 5 | Q 27 | .48 | .08 |
| | | Q 24 | .52 | .10 |
| 12 | 7 | Q 21 | .73 | .17 |
| 13 | 3 | Q 58 | .77 | .14 |

*Variables:

- Q 14--How would you rate students in your school on how hard they try?
- Q 20--How strict do you feel you are in class?
- Q 21--On the average, how much homework do you assign per day?
- Q 24--Which group do you pitch your instruction toward (high, middle, low)?
- Q 27--To what extent do you consider effort when you assign grades?
- Q 30--The main purpose of education should be to teach people what to think.
- Q 37--The primary function of examinations is to help students evaluate their own learning.
- Q 39--Nowadays, schools too often develop everything about the student but his mind.
- Q 41--Making a lesson dramatic often results in students missing the point of the lesson.
- Q 42--Teachers should talk to students just as they would to an adult.
- Q 45--Students learn much from interaction with other students; therefore the teacher should provide abundant opportunity for small-group discussions in the classroom.
- Q 47--A teacher generally ought to engage in a fair amount of sheer repetition.
- Q 55--Even at the risk of boring some students, the teacher should take pains to explain things thoroughly.
- Q 58--Good teaching and genuine affection for students are two separate things and have little, if anything, to do with each other.
- Q 67--Suppose a student were to do a project for extra credit. How likely is it (very, somewhat, not very) that you would give the student a better grade if you knew that the student worked on the project in his/her spare time?

.16 to .36 in reading and mathematics scaled scores. When teacher personal characteristics and teacher attitudes, beliefs and behaviors were combined, R^2 values of .38 and .45 were obtained for reading scaled scores in grades 4 and 5, and R^2 values of .52 and .32 were obtained with mathematics scaled scores in grades 4 and 5. When the student's previous achievement in reading or mathematics was controlled by including the student's scaled score in that subject for the preceding school year, the value of R^2 increased to .52 and .66 with reading scaled scores in grades 4 and 5, and to .71 and .76 with mathematics scaled scores in grades 4 and 5. Although relatively high values of R and R^2 were obtained in these regression equations, the standardized regression coefficients were so unstable that literal interpretation of the standardized regression coefficients produced results that were not sensible.

From the results of the preceding analyses, (e.g., the order of entry of each variable in step-wise regressions and the magnitude of partial correlations), as well as arbitrary (but hopefully informed) judgments on the part of the investigators, it was possible to reduce further the array of variables in each category. In selecting the variables to be retained, we considered the nature and quality of the data, results obtained by other investigators, and intuitively logical relationships between and among variables. As noted previously, six variables describing teacher personal characteristics were retained: (1) satisfaction with teaching, (2) sex, (3) graduate-degree status, (4) number of graduate credits earned in the past 24 months, (5) number of professional magazines and journals read regularly, and (6) years of experience in teaching. Six variables relating to teacher attitudes, beliefs and behaviors also were retained: (1) Q21--on the average, how much homework do you assign per day? (2) Q30--the primary purpose of education should be to teach people what to think, (3) Q41--making a lesson dramatic often results in students missing the point of the lesson, (4) Q42--teachers should talk to students just as they would to an adult, (5) Q47--a teacher generally ought to engage in a fair amount of sheer repetition, and (6) Q55--even at the risk of boring some students, the teacher should take pains to explain things thoroughly. The response set for Q21 ranged from 0 to more than 2 hours per day with half-hour intervals; the response set for the remaining 5 variables was a 5 point Likert scale ranging from "strongly agree" to "strongly disagree."

Findings

Tables 5.6 and 5.7 summarize the results of the final stepwise regression equations in which student scaled scores in mathematics and reading were regressed on variables relating to teacher personal characteristics, attitudes, behaviors and beliefs. Separate regression equations were computed for the third-, fourth- and fifth-grade years in both mathematics and reading. Table 5.6 identifies the variables entering into the equation during each year and the step in which each

Table 5.6

SUMMARY OF FINAL STEPWISE REGRESSION OF VARIABLES RELATING TO TEACHER PERSONAL
CHARACTERISTICS, ATTITUDES, BEHAVIORS, AND BELIEFS, AND
STUDENT SCALED SCORES IN MATHEMATICS AND READING

| | MATHEMATICS | | | | READING | | | |
|-------------------------------|-----------------------------|------------------------|----------------------|-----------------|-----------------------------|------------------------|---------------|-----------------|
| | Stand. Regr. Coefficient | Partial Corr.Coeff. | Sig. Level | Step Entered | Stand. Regr. Coefficient | Partial Corr.Coeff. | Sig. Level | Step Entered |
| Satisfaction w/teaching | | | | | | | | |
| 3rd grade | | | | | | | | |
| 4th grade | -.290 | -.270 | .000 | 6 | | | | |
| 5th grade | | | | | .263 | .171 | .024 | 5 |
| Male/Female | | | | | | | | |
| 3rd grade | | | | | -.446 | -.450 | .000 | 2 |
| 4th grade | .349 | .390 | .000 | 4 | -.767 | -.540 | .000 | 2 |
| 5th grade | | | | | | | | |
| Graduate degree | | | | | | | | |
| 3rd grade | | | | | .203 | .166 | .033 | 9 |
| 4th grade | | | | | -2.405 | -.455 | .000 | 2 |
| 5th grade | .136 | .111 | .183 | 5 | | | | |
| Graduate credits w/24 mos. | | | | | | | | |
| 3rd grade | -.453 | -.381 | .000 | 5 | -.865 | -.537 | .000 | 1 |
| 4th grade | -.454 | -.270 | .000 | 2 | -.110 | .105 | .179 | 11 |
| 5th grade | | | | | .227 | .146 | .055 | 12 |
| Profes. Mag. & Jrnl. | | | | | | | | |
| 3rd grade | 1.356 | .515 | .000 | 4 | .859 | .404 | .000 | 7 |
| 4th grade | | | | | .830 | .423 | .000 | 3 |
| 5th grade | .256 | .210 | .011 | 2 | .928 | .363 | .000 | 10 |
| Yrs. of teaching | | | | | | | | |
| 3rd grade | .616 | .389 | .000 | 1 | .272 | .239 | .000 | 8 |
| 4th grade | -.171 | -.151 | .065 | 7 | | | | |
| 5th grade | -.491 | -.479 | .000 | 1 | 1.682 | .450 | .000 | 3 |
| Q 21 | | | | | | | | |
| 3rd grade | | | | | | | | In 3 Out 11 |
| 4th grade | .182 | .234 | .003 | 5 | -.632 | -.386 | .000 | 8 |
| 5th grade | | | | | .754 | .412 | .000 | 8 |
| Q 30 | | | | | | | | |
| 3rd grade | 2.044 | .556 | .000 | 3 | .881 | .430 | .000 | 5 |
| 4th grade | .465 | .407 | .000 | 1 | | | | |
| 5th grade | | | | | .463 | .222 | .003 | 11 |
| Q 41 | | | | | | | | |
| 3rd grade | | | | | .907 | .495 | .000 | 4 |
| 4th grade | | | | | .774 | .452 | .000 | 4 |
| 5th grade | | | | | | | | In 1 Out 6 |
| Q 42 | | | | | | | | |
| 3rd grade | .151 | .138 | .055 | 6 | .610 | .370 | .000 | 6 |
| 4th grade | -.247 | -.184 | .024 | 3 | | | | In 5 |
| 5th grade | .205 | .235 | .004 | 3 | -1.258 | -.396 | .000 | Out 10 7 |
| Q 47 | | | | | | | | |
| 3rd grade | -1.840 | -.602 | .000 | 2 | -.626 | -.315 | .000 | 10 |
| 4th grade | | | | | -.574 | -.368 | .000 | 7 |
| 5th grade | | | | | .606 | .195 | .010 | 9 |
| Q 55 | | | | | | | | |
| 3rd grade | | | | | .584 | .426 | .000 | 9 |
| 4th grade | | | | | | | | In 1 |
| 5th grade | .155 | .179 | .030 | 4 | .418 | .239 | .001 | Out 6 4 |
| | | <u>R</u> | <u>R²</u> | | <u>R</u> | <u>R²</u> | | |
| 3rd grade | | .6814 | .4643 | | .6711 | .4504 | | |
| 4th grade | | .7223 | .5217 | | .6126 | .3723 | | |
| 5th grade | | .51 | .3193 | | .6684 | .4468 | | |

Table 5.7

SUMMARY OF STEPS, STEPWISE REGRESSION OF MATHEMATICS AND
READING SCALED SCORES ON TEACHER PERSONAL CHARACTERISTICS,
ATTITUDES, BEHAVIORS, AND BELIEFS

| Step No. | Variable | In/Out | R | R ² | Change in R ² | Sig. Level |
|------------------------|----------|--------|-------|----------------|-----------------------------|---------------|
| Mathematics--3rd Grade | | | | | | |
| 1 | YRSTEACH | In | .250 | .0626 | .0626 | .000 |
| 2 | Q 47 | In | .315 | .0992 | .0366 | .005 |
| 3 | Q 30 | In | .425 | .1809 | .0817 | .000 |
| 4 | NMAGJRNL | In | .610 | .3723 | .1914 | .000 |
| 5 | NGRAD24 | In | .674 | .4538 | .0815 | .000 |
| 6 | Q 42 | In | .6814 | .4643 | .0105 | .055 |
| Mathematics--4th Grade | | | | | | |
| 1 | Q 30 | In | .506 | .2561 | .2561 | .000 |
| 2 | NGRAD24 | In | .593 | .3515 | .0954 | .000 |
| 3 | Q 42 | In | .641 | .4107 | .0592 | .000 |
| 4 | MALEFEM | In | .671 | .4502 | .0394 | .001 |
| 5 | Q 21 | In | .694 | .4821 | .0319 | .003 |
| 6 | SATWTCH | In | .714 | .5105 | .0284 | .004 |
| 7 | YRSTEACH | In | .722 | .5217 | .0112 | .065 |
| Mathematics--5th Grade | | | | | | |
| 1 | YRSTEACH | In | .345 | .1188 | .1188 | .000 |
| 2 | NMAGJRNL | In | .496 | .2457 | .1269 | .000 |
| 3 | Q 42 | In | .528 | .2789 | .0332 | .011 |
| 4 | Q 55 | In | .558 | .3108 | .0370 | .010 |
| 5 | GRADEGRE | In | .565 | .3193 | .0085 | .183 |
| Reading--3rd Grade | | | | | | |
| 1 | NGRAD24 | In | .350 | .1228 | .1228 | .000 |
| 2 | MALEFEM | In | .465 | .2165 | .0937 | .000 |
| 3 | Q 21 | In | .518 | .2680 | .0515 | .000 |
| 4 | Q 41 | In | .544 | .2959 | .0279 | .006 |
| 5 | Q 30 | In | .582 | .3385 | .0427 | .000 |
| 6 | Q 42 | In | .615 | .3781 | .0396 | .001 |
| 7 | NMAGJRNL | In | .642 | .4115 | .0334 | .001 |
| 8 | YRSTEACH | In | .659 | .4345 | .0230 | .006 |
| 9 | Q 55 | In | .664 | .4416 | .0070 | .121 |
| 10 | Q 47 | In | .673 | .4532 | .0116 | .045 |
| 11 | Q 21 | Out | .6711 | .4505 | -.0028 | .324 |
| Reading--4th Grade | | | | | | |
| 1 | Q 55 | In | .272 | .0737 | .0737 | .000 |
| 2 | MALEFEM | In | .373 | .1390 | .0653 | .000 |
| 3 | NMAGJRNL | In | .436 | .1901 | .0510 | .001 |
| 4 | Q 41 | In | .505 | .2548 | .0647 | .000 |
| 5 | Q 42 | In | .527 | .2775 | .0227 | .024 |
| 6 | Q 55 | Out | .527 | .2772 | -.0003 | .791 |
| 7 | Q 47 | In | .556 | .3088 | .0316 | .007 |
| 8 | Q 21 | In | .598 | .3578 | .0490 | .001 |
| 9 | GRADEGRE | In | .6081 | .3698 | .0120 | .079 |
| Reading--5th Grade | | | | | | |
| 1 | Q 41 | In | .258 | .0663 | .0663 | .000 |
| 2 | GRADEGRE | In | .447 | .1998 | .1336 | .000 |
| 3 | YRSTEACH | In | .494 | .2436 | .0438 | .002 |
| 4 | Q 55 | In | .514 | .2639 | .0203 | .028 |
| 5 | SATWTCH | In | .541 | .2928 | .0289 | .008 |
| 6 | Q 41 | Out | .539 | .2905 | -.0023 | .453 |
| 7 | Q 42 | In | .558 | .3117 | .0212 | .021 |
| 8 | Q 21 | In | .579 | .3355 | .0238 | .013 |
| 9 | Q 47 | In | .601 | .3616 | .0261 | .008 |
| 10 | NMAGJRNL | In | .631 | .3980 | .0364 | .001 |
| 11 | Q 30 | In | .659 | .4347 | .0368 | .001 |
| 12 | NGRAD24 | In | .668 | .4468 | .0120 | .055 |

variable entered. It should be noted that these regressions were deliberately run to a very loose criterion and must be interpreted accordingly. A coefficient greater than 1.0 should be regarded as a numerical artifact and a coefficient greater than .50 is at least suspect.

The regressions using student scaled score in mathematics as the dependent variable produced multiple correlations of .68, .72 and .57 for third, fourth and fifth grade, respectively. Corresponding values of the coefficient of determination (R^2) were .46, .52, and .32, respectively. Years of teaching experience entered the equation in each of the three years, entering first in grades 3 and 5, and seventh in grade 4. However, the relationship between years of teaching and academic achievement in mathematics was quite unstable, with standardized regression coefficients of .62, -.17, and -.49. Question 42 (teachers should talk to students just as they would to an adult) also entered the equation during each of the three years, entering sixth in grade 3 and third in grades 4 and 5. It also was rather unstable, with standardized regression coefficients of .15, -.25, and .20 during the three years, respectively.

Three other variables each appeared in the final regression in two of the three years. Graduate credits completed within the past 24 months entered fifth in grade 3 and second in grade 4. The standardized regression coefficient was negative in both grade 3 and grade 4. Number of professional magazines and journals read regularly entered fourth in grade 3 and second in grade 5, with positive standardized regression coefficients each year (1.36 and .26). Question 30 (the main purpose of education should be to teach people what to think) entered the equation third in grade 3 and first in grade 4. In both instances, the standardized regression coefficient was positive, although the large coefficient in third grade is disconcerting. Of the 12 variables considered, only one (question 41) did not enter the final stepwise regression equation in any of the three years.

With regard to reading, the final stepwise regression equation produced a multiple correlation of .67 in grade 3, .61 in grade 4, and .67 in grade 5. The corresponding values of R^2 were .45, .38, and .45, respectively. Three variables entered the final regression equation in each of the three years. Number of graduate credits completed within the past 24 months entered first in grade 3, but not until 11th in grade 4 and 12th in grade 5. The standardized regression coefficient was negative in grade 3 but positive in grades 4 and 5. Number of professional magazines and journals read regularly entered seventh in grade 3, third in grade 4, and tenth in grade 5. The standardized regression coefficient was positive in each of the three years and the values were similar. Question 47 (a teacher generally ought to engage in a considerable amount of sheer repetition) entered tenth in grade 3, seventh in grade 4, and ninth in grade 5. The standardized regression coefficient was negative in two of these three years.

Seven variables each entered the final regression equation during two of the three years. Teacher gender was the second variable entered in grade 3 and grade 4, with a negative standardized regression coefficient in each year. Graduate-degree status entered ninth in grade 4 and second in grade 5, with a small positive value in grade 4 and a large negative value in grade 5. Years of teaching experience entered eighth in grade 3 and third in grade 5, with positive standardized regression coefficients in each year (but with widely disparate values). Question 21 (on the average, how much homework do you assign per day?), entered third in grade 3 (but was removed from the equation in step eleven) and entered eighth in grade 4 and grade 5. Its standardized regression coefficient was negative in grade 4 and positive in grade 5. Question 30 (the main purpose of education should be to teach people what to think) entered fifth in grade 3 and eleventh in grade 5, with positive standardized regression coefficients each year. Question 41 (making a lesson dramatic often results in students missing the point of the lesson) entered fourth in grades 3 and 4, and entered first in grade 5 (but was removed at step six). In both grade 3 and grade 4, the standardized regression coefficient was positive and of similar size. Question 42 (teachers should talk to students just as they would to an adult) entered sixth in grade 3, entered fifth in grade 4 (but was removed from the equation at the tenth step), and entered seventh in grade 5. The standardized regression coefficient was positive at grade 3 and negative at grade 5, with very disparate values in the two years in which it remained in the equation. Question 55 (even at the risk of boring some students, the teacher should take pains to explain things thoroughly) entered ninth in grade 3, entered first in grade 4 (but was removed from the equation at step six), and entered fourth in grade 5. In both grade 3 and grade 5, the standardized regression coefficient was positive and similar in value.

In summary, the results of the stepwise regression analyses described above are a bit disheartening. One would hope that the regression coefficients would be consistent and stable, or at least that they would change in an orderly fashion. Unfortunately, the few variables which consistently entered the final regression equations tended to be quite unstable, showing positive standardized regression coefficients in some years and negative coefficients in other years. Four variables--graduate credits earned in the past 24 months, number of professional magazines and journals read regularly, years of teaching experience, and whether teachers should talk to students just as they would to an adult--entered and remained in the final regression equation in five of the six cases. Of these variables, only the number of professional magazines and journals read regularly displayed relatively stable standardized regression coefficients. Each of the other three variables exhibited both positive and negative standardized regression coefficients and disparate values for the standardized regression coefficients.

Two other variables--question 30 dealing with whether the main purpose of education should be to teach people what to think and question 47 dealing with whether a teacher generally ought to engage in

a considerable amount of sheer repetition--each entered and remained in the final regression equation in four of six cases. All standardized regression coefficients for question 30 were positive but varied widely, while those for question 47 showed both positive and negative values.

The variables entering the final regression equation in mathematics for the three years accounted for between 32% and 52% of the variance in mathematics scaled scores. Similarly, the final regression equations in reading explained from approximately 38% to 45% of the variance in reading scaled scores in the three years. Thus, a substantial amount of unexplained variance remains. Furthermore, the analyses did not reveal a set of teacher-related variables with consistent, stable relationships to student scaled scores in mathematics and reading.

The same regression procedures also were employed with the student's scaled score at the close of the preceding school year included as a control. The results of the final stepwise regression equations when the student's previous scaled score was controlled are shown in Tables 5.8 and 5.9. Since the student's scaled score at the end of grade 2 was not available, this analysis could be performed only for grades 4 and 5. Including the student's scaled score at the close of the previous school year substantially increased the coefficient of multiple correlation in both mathematics and reading. The values of R and R^2 for mathematics in fourth grade were .85 and .72, and the values for fifth grade were .87 and .76.

For reading, the corresponding values were .72 and .52 for fourth grade, and .81 and .66 for fifth grade. The previous scaled score always was the first variable entered, and it alone accounted for from 60% to 73% of the variance in mathematics scaled scores and from 48% to 62% of the variance in reading scaled scores. As will be noted from the data presented in Table 5.9, the teacher-related variables which entered the equation accounted for an additional 11% of the variance in mathematics scaled scores at fourth grade, but only an additional 4% at fifth grade. In reading, the teacher-related variables explained an additional 3% of the variance in reading scaled scores at fourth grade and an additional 4.5% at fifth grade.

Only one teacher-related variable, graduate credits in the past 24 months, entered the final equation for mathematics in both years. It was the third variable entered in both fourth and fifth grade, with a negative standardized regression coefficient at fourth grade and a positive coefficient at fifth grade. Graduate-degree status was the only variable entering the final equation during both years for reading. It entered at the fourth step in each year, with a negative standardized regression coefficient each year. Years of teaching experience entered in the fifth-grade equation in both mathematics and reading, with a negative standardized regression coefficient in mathematics and a positive coefficient in reading. Question 30 (the main purpose of education should be to teach people what to think) entered the fourth-grade equation in both mathematics and reading, but with a

Table 5.8

SUMMARY OF FINAL STEPWISE REGRESSION OF STUDENT SCALED SCORES IN
 MATHEMATICS AND READING ON TEACHER PERSONAL CHARACTERISTICS,
 ATTITUDES, BEHAVIORS, AND BELIEFS, CONTROLLING FOR STUDENT'S
 SCALED SCORES AT CLOSE OF PREVIOUS SCHOOL YEAR

| | MATHEMATICS | | | | READING | | | |
|-------------------------------|-----------------------------|-----------------------|---------------|-----------------|-----------------------------|-----------------------|---------------|-----------------|
| | Stand. Regr. Coefficient | Partial Corr.Coef. | Sig. Level | Step Entered | Stand. Regr. Coefficient | Partial Corr.Coef. | Sig. Level | Step Entered |
| Satisfaction w/teaching | | | | | | | | |
| 4th grade | -.155 | -.209 | .010 | 5 | | | | |
| 5th grade | | | | | | | | |
| Male/Female | | | | | | | | |
| 4th grade | .227 | .344 | .000 | 2 | | | | |
| 5th grade | | | | | | | | |
| Graduate degree | | | | | | | | |
| 4th grade | .199 | .223 | .006 | 6 | -.090 | -.122 | .116 | 4 |
| 5th grade | | | | | -.246 | -.239 | .001 | 4 |
| Graduate credits w/24 mos. | | | | | | | | |
| 4th grade | -.160 | -.246 | .002 | 3 | | | | |
| 5th grade | .063 | .123 | .138 | 3 | | | | |
| Profea. Mag. & Jrnl. | | | | | | | | |
| 4th grade | | | | | | | | |
| 5th grade | | | | | -.080 | -.105 | .160 | 2 |
| Yrs. of teaching | | | | | | | | |
| 4th grade | | | | | | | | |
| 5th grade | -.138 | -.254 | .002 | 2 | .236 | .259 | .000 | 3 |
| Q 21 | | | | | | | | |
| 4th grade | -.132 | -.142 | .083 | 7 | | | | |
| 5th grade | | | | | | | | |
| Q 30 | | | | | | | | |
| 4th grade | .191 | .238 | .003 | 4 | -.144 | -.195 | .011 | 3 |
| 5th grade | | | | | | | | |
| Q 41 | | | | | | | | |
| 4th grade | | | | | | | | |
| 5th grade | | | | | | | | |
| Q 42 | | | | | | | | |
| 4th grade | | | | | | | | |
| 5th grade | .088 | .158 | .057 | 4 | | | | |
| Q 47 | | | | | | | | |
| 4th grade | | | | | | | | |
| 5th grade | -.064 | -.116 | .164 | 5 | | | | |
| Q 55 | | | | | | | | |
| 4th grade | | | | | .144 | .193 | .012 | 2 |
| 5th grade | | | | | | | | |
| Previous Scaled score | | | | | | | | |
| 4th grade | .613 | .648 | .000 | 1 | .649 | .673 | .000 | 1 |
| 5th grade | .816 | .843 | .000 | 1 | .718 | .755 | .000 | 1 |
| | <u>R</u> | <u>R</u> ² | | | <u>R</u> | <u>R</u> ² | | |
| 4th grade | .8476 | .7185 | | | .7213 | .5202 | | |
| 5th grade | .8725 | .7612 | | | .8135 | .6618 | | |

Table 5.9

SUMMARY OF STEPS, STEPWISE REGRESSION OF MATHEMATICS AND READING
 SCALED SCORES ON TEACHER PERSONAL CHARACTERISTICS, ATTITUDES,
 BEHAVIORS AND BELIEFS, CONTROLLING FOR STUDENT'S SCALED SCORE
 AT CLOSE OF PREVIOUS SCHOOL YEAR

| Step. No. | Variable | In/Out | R | R ² | Change in R ² | Sig. Level |
|------------------------|----------|--------|------|----------------|-----------------------------|---------------|
| Mathematics--4th Grade | | | | | | |
| 1 | PREVSS | In | .779 | .6073 | .6073 | .000 |
| 2 | MALEFEM | In | .813 | .6605 | .0531 | .000 |
| 3 | NGRAD24 | In | .830 | .6893 | .0288 | .000 |
| 4 | Q 30 | In | .834 | .6953 | .0060 | .087 |
| 5 | SATWTCH | In | .838 | .7031 | .0078 | .049 |
| 6 | GRADEGRE | In | .844 | .7127 | .0096 | .027 |
| 7 | Q 21 | In | .848 | .7185 | .0058 | .083 |
| Mathematics--5th Grade | | | | | | |
| 1 | PREVSS | In | .855 | .7303 | .7303 | .000 |
| 2 | YRSTEACH | In | .865 | .7479 | .0176 | .002 |
| 3 | NGRAD24 | In | .868 | .7543 | .0064 | .053 |
| 4 | Q 42 | In | .871 | .7580 | .0037 | .140 |
| 5 | Q 47 | In | .872 | .7612 | .0032 | .164 |
| Reading--4th Grade | | | | | | |
| 1 | PREVSS | In | .693 | .4806 | .4806 | .000 |
| 2 | Q 55 | In | .706 | .4982 | .0177 | .016 |
| 3 | Q 30 | In | .716 | .5130 | .0148 | .026 |
| 4 | GRADEGRE | In | .721 | .5202 | .0072 | .116 |
| Reading--5 Grade | | | | | | |
| 1 | PREVSS | In | .785 | .6166 | .6166 | .000 |
| 2 | NMAGJRNL | In | .796 | .6345 | .0178 | .003 |
| 3 | YRSTEACH | In | .801 | .6413 | .0069 | .066 |
| 4 | GRADEGRE | In | .814 | .6618 | .0205 | .001 |

positive standardized regression coefficient in mathematics and a negative coefficient in reading. Three variables did not enter the final regression equation in mathematics in either of the two years-- number of professional magazines and journals read, question 41 (making a lesson dramatic often results in students missing the point of the lesson), and question 55 (even at the risk of boring some students, the teacher should take pains to explain things thoroughly). Seven variables did not enter the reading regression equation in either year. They included satisfaction with teaching, sex, graduate credits in the last 24 months, and questions 21, 41, 42, and 47.

The availability of data concerning the percentage of time students were on-task in reading and in mathematics provided a direct measure of one aspect of the instructional behavior of the teachers in the sample. The average percentage of time each student was on-task in reading (and in mathematics) was computed and used as an additional variable in regressions with the variables described previously. The "best" regression equation was ascertained, together with other regression equations using variables drawn from the same set that provided solutions nearly as good as the "best" equation. The results confirmed the previous finding that no single set of variables describing teacher personal characteristics, attitudes, behaviors and beliefs was consistently superior to any other in accounting for variation in student scaled scores.

Table 5.10 provides standardized regression coefficients for the variables included in 14 equations in which student reading achievement in grade 5 was regressed on teacher personal characteristics, attitudes, behaviors and beliefs. The "best" equation produced a multiple correlation coefficient of .558; the "poorest" of the 14 equations produced a multiple correlation coefficient of .526. Five of the thirteen variables did not enter any of the 14 equations. Two variables, graduate-degree status and years of teaching experience, entered each of the 14 equations. Percent of time students were on task entered 10 of the 14 equations, including each of the six "best" equations. The standardized regression coefficients were quite stable. Graduate-degree status, for example, was consistently negative, and the values were quite similar. The coefficients for years of teaching experience were consistently positive, as were those for percentage of time on-task.

Discussion

It perhaps goes without saying, but one must nevertheless caution that broad generalizations based on the results of the analyses described in this paper are not warranted. First, the sample of teachers is small (from 10 to 17 depending upon the subject and year). Second, the sample of teachers was not randomly selected; it consisted of teachers who taught the particular grade and subject in the sample

Table 5.10

STANDARDIZED REGRESSION COEFFICIENTS AND R VALUE FOR FOURTEEN EQUATIONS REGRESSING
STUDENT READING ACHIEVEMENT SCORES AT GRADE 5 ON TEACHER PERSONAL CHARACTERISTICS,
ATTITUDES, BEHAVIORS, AND BELIEFS

| Variable | Equation Number | | | | | | | | | | | | | |
|----------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| SATWTCH | | | | | | | | | | | | | | |
| Q 21 | | | | | | | | | | | | | | |
| Q 30 | .149 | .161 | .169 | | | | .115 | .130 | .116 | .136 | .101 | | | .202 |
| Q 41 | | | -.006 | .146 | .180 | | | -.046 | .210 | -.016 | .228 | .317 | .106 | |
| Q 42 | | | | | | | | | | | | | | |
| Q 47 | | | | | | | | | | | | | | |
| Q 55 | .255 | .222 | .218 | .228 | .174 | .303 | .293 | .318 | | .256 | | | .273 | |
| MALEFEM | .066 | | | .086 | | .117 | .087 | .112 | -.052 | | | -.037 | .102 | -.091 |
| GRADEGRE | -.670 | -.632 | -.641 | -.671 | -.618 | -.702 | -.726 | -.751 | -.541 | -.680 | -.555 | -.543 | -.722 | -.511 |
| NGRAD24 | | .035 | | | .043 | .010 | .035 | | | .079 | -.012 | .023 | .033 | .040 |
| NMAGJRNL | | | | | | | | | | | | | | |
| YRSTEACH | .561 | .540 | .534 | .491 | .440 | .618 | .636 | .670 | .353 | .620 | .360 | .310 | .582 | .485 |
| %ONTASK | .167 | .171 | .178 | .148 | .152 | .137 | | | .195 | | .191 | .175 | | .203 |
| R | .558 | .556 | .555 | .545 | .543 | .541 | .536 | .536 | .535 | .533 | .533 | .528 | .528 | .526 |

schools and thus may be biased in unknown fashion. Third, the students involved were predominantly from white, Anglo-Saxon, middle- and lower-middle class homes in small and medium-sized cities in one midwestern state. Finally, it should be noted that we were seeking insights into how human resources, in this instance, the qualities and characteristics of teachers, might bear upon the academic achievement of these students; we were not attempting to either predict student achievement or to ascribe cause-and-effect relationships.

Having noted these caveats, it is somewhat discouraging to find that no single set of teacher-related variables showed consistently stable relationships with student achievement across grade levels and subjects. Rather, we found that one subset of variables was about as good as another, at least in terms of the multiple correlation coefficients they produced. This finding may be due to any one (or a combination) of several factors.

It is possible, for example, that the way in which teacher personal characteristics, attitudes and beliefs bear upon academic achievement of their students does vary from grade to grade and from subject to subject. (We have other data that show the strength of teacher affiliation declined greatly as these students progressed from third to fourth to fifth grade.) It is also possible that the variables we used did not capture the crucial attributes that affect student learning, either because we selected the wrong variables or because our instruments were not sufficiently sensitive. Another possibility is that each teacher-student dyad is so unique that disaggregated data are not useful, or perhaps that certain teacher attributes are especially important in dealing with certain types of students and that such relationships are "washed out" when disaggregated data are used.

Although the relationships were not as consistent and stable as would be desirable, certain variables did appear in the final step-wise regression equations quite consistently. Years of teaching experience entered the equation frequently, generally was one of the first variables to enter, and usually produced standardized regression coefficients with positive values. The number of professional magazines and journals read regularly also proved to be a useful variable. It appeared in the final step-wise regressions frequently, usually entered quite early, and produced stable standardized regression coefficients. On the other hand, several variables seldom entered the final stepwise regression equations, or entered late and contributed little to the multiple correlation coefficient. Satisfaction with teaching, for example, was not very useful, and some of the attitude and belief questions contributed little additional information.

One may view the results of these analyses as similar to a glass that is either half full or half empty, depending on one's point of view. That is, the variables consistently produced multiple correlation coefficients larger than .50, with some as high as .72. Thus, these teacher-related variables did account for a substantial amount of the variance in students' achievement scores in reading and mathematics.

When the student's previous academic achievement in the subject is taken into account, however, it is evident that teachers are working at the margin in terms of their effect on student achievement. While teachers do make a difference, the difference is likely to vary from student to student and from grade to grade, and is constrained by numerous factors beyond the control of the teacher or school. As to the particular teacher-related variables that are most directly and consistently associated with student academic achievement, one is tempted to say "pay your money and take your choice!" That is, numerous combinations of variables seem to be about equally efficient in describing the association between teacher-related variables and student academic achievement in reading and mathematics.

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SECTION VI

SCHOOL RESOURCES, HOME ENVIRONMENT, AND GAIN IN STUDENT ACHIEVEMENT GRADES 3-5

The belief that children learn best when the home and school are mutually supportive and work in concert has long been prevalent in educational circles. The relative importance of each institution in the overall educational process, and the specific ways in which the home and the school either reinforce or negate each other's efforts, is far from clear. The Coleman Report (1966), with its emphasis on the primacy of the home, served to kindle more heated debate rather than to clarify the relationships. There currently appears to be a reaffirmation of the importance of both the home and the school in the learning of children, but still little understanding of the precise nature or the effects of various linkages. This section draws upon the data described and analyzed in the preceding five sections to probe for the linkages between school- and home-related variables and students' gain in academic achievement between the end of grade 3 and the end of grade 5.

A growing body of research supports the view that schools and teachers do, indeed, make a difference in the learning of children. Studies conducted during the early 1970s by Murnane (1975) and Summers and Wolfe (1977) provided evidence that teachers exert considerable influence on student learning. The body of research on effective schools published during the past ten years lends strong support to the view that student achievement is higher in schools where there is a clear focus on academic goals, appropriately structured learning activities, teaching methods which focus on the learning task to be accomplished, and an expectation of high achievement by students (Armor et al., 1976; Brookover et al., 1979; Brophy, 1979; Glenn, 1981; Venezky and Winfield, 1979; and Purkey and Smith, 1983).

There also is ample literature dealing with family characteristics and student performance in school. Iverson and Walberg (1982) identified four "schools" of research in this area: the socioeconomic school, the family constellation school (emphasizing family size and birth order, etc.), the British school (emphasizing parental attitudes and expectations), and the Chicago school (emphasizing family behavior and parent-child interactions). These are not competing schools of thought; researchers identified with one school rarely discount the significance of work done by others.

It has been well established that a strong relationship exists between socioeconomic status and student achievement (Coleman et al., 1966). However, the mechanisms through which socioeconomic advantages are transmitted are not well understood. There also are conceptual problems in using socioeconomic factors as independent variables because they tend to lump a variety of factors into a single index. Olson (1985) has observed, "Although many associations have been identified between achievement and factors measuring socioeconomic status, family constellation, parents' attitudes and expectations for their children, and the quality and quantity of parent-child interactions, in most cases

the dynamics of the relationships are not well understood." It also should be noted that many researchers have used samples comprised of urban and and/or "disadvantaged" children. Whether findings derived from these studies are generalizable to populations with very different demographic characteristics is uncertain.

Methodology

The development of a data base suitable for examining simultaneously the relationships between student achievement and home, school, and teacher variables involved a rather complex procedure. The interviews with parents of students in the sample produced over 100 variables dealing with the characteristics of the family, the student's use of time out of school (including homework), activities in which the student was involved out of school, and parental perceptions of the school's effectiveness and the academic progress of their child. Through a series of cluster analysis and factor analysis procedures (described in Section IV), a limited number of the most potent variables were identified and multiple regression procedures were then used to identify relationships between these variables and students' academic achievement (Olson, 1985). The variables found most useful in explaining variance in student achievement and progress were selected for inclusion in the analyses reported in this section.

The information gathered about teachers included a large number of variables reflecting teacher personal characteristics, instructional behaviors, professional attitudes and beliefs. Three procedures (described in Section V) were used in analyzing these data. First, teacher-student dyads were constructed so that a specific teacher could be associated with a specific student's academic achievement in reading or mathematics. Second, the data were reduced to a small set of noncollinear variables using cluster analysis and factor analysis procedures. Third, the variables which survived this screening were used in multiple regression equations to identify those which were most useful in explaining variance in student achievement (Rossmiller, 1985), and these variables were used in the analyses described in this section.

Multiple regression procedures (described in Section II) were used to examine relationships between students' use of time in school and their academic achievement. The analyses included the five modes of instruction for which on-task data were gathered as well as time spent in process activities and off-task. The time on-task in various instructional modes was found not to be related strongly or consistently to student academic achievement (Rossmiller, 1983). Consequently, a composite percentage of the on-task time and off-task time in reading and in mathematics was employed in the analyses reported in this paper.

Data on expenditures also were collected and, through the use of information concerning the distribution of time to various curricular subjects during each of the three years, it was possible to estimate accurately the expenditure per student for instruction in various school subjects, including reading and mathematics. The analysis of

relationships between expenditure per pupil and student achievement (described in Section III) yielded no statistically significant relationships (Frohreich, 1986). Consequently, no data concerning expenditures were included in the analyses reported in this section.

As a result of the foregoing procedures, 24 independent variables were identified for inclusion in the analyses reported in this section. Two variables related directly to students (academic aptitude and gender), 8 variables reflected aspects of the student's home environment, 12 variables reflected teacher characteristics, and 2 variables reflected student use of time in school (on- or off-task). These variables are identified and described in Table 6.1.

Population

Although a total of 281 students were observed during the course of the study, the population available for this analysis was considerably smaller, primarily because only students for whom complete achievement data were available for each year of the study could be used. The creation of teacher-student dyads also reduced the available sample, since a teacher was included in the analysis only if at least five teacher-student dyads could be identified. For the analysis of reading gains, a sample of 100 students was available for the analysis of gains from grade 3 to grade 4, and 95 students were available for the analysis of gains from grade 4 to grade 5 and from grade 3 to grade 5. For the analysis of gain in mathematics, 100 students were available for the analysis of gain from grade 3 to grade 4, and 71 students were available for the analysis of gains from grade 4 to grade 5 and from grade 3 to grade 5.

Analyses

Stepwise multiple regression with forward selection was used in the analysis of the data to identify relationships between home-, school-, and teacher-related variables and the gain in mathematics achievement and reading achievement demonstrated by students from the end of grade 3 to the end of grade 4, from the end of grade 4 to the end of grade 5, and from the end of grade 3 to the end of grade 5. In addition, home-related variables and school- and teacher-related variables were examined in separate regression analyses for the gain demonstrated by students in the sample from the end of grade 3 to the end of grade 5.

Findings

Reading

Tables 6.2, 6.3, and 6.4 summarize the results of the stepwise regression equations in which students' scaled scores in reading were regressed on home-, school-, and teacher-related variables. Separate regression equations were computed for the gain in student achievement

Table 6.1

Description of Home-, School-, and Teacher-Related Variables
Used in Step-wise Regression Analyses

GAIN--Difference () in score on Stanford Achievement Test in reading or mathematics, Grade 3-4, Grade 4-5, Grade 3-5

WTCH--Teacher identifier

-Q 21--On the average, how much homework do you assign per day?

-Q 30--The main purpose of education should be to teach people what to think.

-Q 41--Making a lesson dramatic often results in students missing the point of the lesson.

-Q 42--Teachers should talk to students just as they would to an adult.

-Q 47--A teacher generally ought to engage in a fair amount of sheer repetition.

-Q 55--Even at the risk of boring some students, the teacher should take pains to explain things thoroughly.

TCHMF--Teacher's gender

TGRDEG--Whether teacher holds a graduate degree

NGR24--Number of graduate credits earned by teacher in past 24 months.

NMAGJ--Number of magazines and journals teacher reads

YTCH--Year of teaching experience

PON--Percent of time student was on-task in reading or mathematics.

POFF--Percent of time student was off-task in reading or mathematics.

ACAPT--Student's academic aptitude score

SMALEFEM--Student's gender

HOMEWORK--Number of minutes/day student spends on homework.

SPORTS--Number of sports in which student is involved.

XMAWORK--Number of hours/week mother is employed

ARTMUSIC--Number of art or music activities in which student is involved.

MASKUL--Number of years of schooling completed by student's mother

STRACAD--Parent's perception of whether or not the school has a strong academic program.

READMATL--Number of items of reading material in student's home

MAWORK--Whether or not student's mother employed outside the home

TABLE 6.2

Regression of Student Gain in Reading Scaled Score, Grade 3-4, on Home, School, and Teacher Variables

| Variable | Reg Coe | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 94 Deg. Freedom | Sig. Level |
|--------------|---------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Constant | .048 | .059 | | .084 | .667 | .415 |
| 2 WTCH | | | | .029 | | .783 |
| 3 Q30 | | | | .004 | | .971 |
| 4 Q30 | -.184 | .058 | -.285 | -.310 | 10.004 | .002 |
| 5 Q41 | | | | .166 | | .108 |
| 6 Q42 | | | | .054 | | .601 |
| 7 Q47 | | | | .060 | | .562 |
| 8 O55 | | | | .101 | | .328 |
| 9 TCHMF | | | | -.021 | | .843 |
| 10 TGRDFG | | | | -.055 | | .594 |
| 11 NGR24 | | | | -.087 | | .401 |
| 12 MMAGJ | | | | -.107 | | .301 |
| 13 YTCH | | | | .052 | | .618 |
| 14 PONR | .150 | .057 | .236 | .260 | .02 | .010 |
| 15 POFFR | | | | .026 | | .860 |
| 16 ACAPT | -.107 | .061 | -.158 | -.177 | 3.036 | .084 |
| 17 SMAI EFFM | | | | .032 | | .756 |
| 18 HOMEWORK | | | | .135 | | .193 |
| 19 SPORTS | | | | .146 | | .158 |
| 20 XMAWORK | | | | -.031 | | .763 |
| 21 ARTMUSIC | .117 | .060 | .178 | .198 | 3.835 | .053 |
| 22 MASKUL | .112 | .058 | .177 | .196 | 3.737 | .056 |
| 23 STRACAD | | | | .078 | | .454 |
| 24 READMATL | | | | .073 | | .481 |
| 25 MAWORK | | | | -.111 | | .283 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 9.72088 | 5 | 1.94418 |
| Residuals from Regression | 31.39041 | 94 | .33394 |
| Corrected Total | 41.11129 | 99 | |

F-Ratio = 5.82 with 5 and 4 Deg. Freedom
Significance Level of F-Ratio = .0001

TABLE 6.3

Regression of Student Gain in Reading Scaled Score, Grade 4-5, on Home, School, and Teacher Variables

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 89 Deg. Freedom | Sig. Level |
|---|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Multiple Correlation Coefficient..... | | | | | .4599 | |
| Coefficient of Determination..... | | | | | .2115 | |
| Corrected Coefficient of Determination..... | | | | | .1672 | |
| Constant | .001 | .072 | | .001 | .000 | .791 |
| 2 WTCH | | | | -.030 | | .775 |
| 3 Q21 | | | | -.050 | | .638 |
| 4 Q30 | | | | .010 | | .926 |
| 5 Q41 | | | | .007 | | .948 |
| 6 Q42 | | | | .024 | | .747 |
| 7 Q47 | .133 | .069 | .278 | .09 | 3.686 | .058 |
| 8 Q55 | | | | -.002 | | .987 |
| 9 TCHMF | | | | .019 | | .858 |
| 10 TGRDEG | -.387 | .124 | -.596 | -.313 | 9.657 | .002 |
| 11 NGR24 | | | | -.064 | | .546 |
| 12 NMACJ | | | | .047 | | .657 |
| 13 YTCH | .373 | .167 | .377 | .230 | 4.991 | .028 |
| 14 PONR | | | | -.015 | | .886 |
| 15 POFER | | | | -.011 | | .916 |
| 16 ACAPT | .133 | .069 | .201 | .201 | 3.739 | .056 |
| 17 SMALEFEM | | | | -.079 | | .457 |
| 18 HOMEWORK | | | | -.121 | | .257 |
| 19 SPORTS | | | | .079 | | .459 |
| 20 XMAWORK | | | | .049 | | .644 |
| 21 ARTMUSIC | | | | -.042 | | .691 |
| 22 MASKUT. | | | | -.087 | | .416 |
| 23 STRACAD | -.120 | .063 | -.184 | -.197 | 3.586 | .061 |
| 24 READMATL | | | | -.040 | | .706 |
| 25 MAWORK | | | | .128 | | .228 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 8.35497 | 5 | 1.67099 |
| Residuals from Regression | 31.14360 | 89 | .34993 |
| Corrected Total | 39.49857 | 94 | |

F-Ratio = 4.78 with 5 and 89 Deg. Freedom
Significance Level of F-Ratio = .0007

TABLE 6.4

Regression of Student Gain in Reading Scaled Score, Grade 3-5, on Home, School, and Teacher Variables

Multiple Correlation Coefficient4749
 Coefficient of Determination..... .2255
 Corrected Coefficient of Determination..... .1727

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 88 Deg. Freedom | Sig. Level |
|-------------|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Constant | -.104 | .067 | | -.162 | 2.383 | .126 |
| 2 ACAPT | .117 | .067 | .170 | .183 | 3.046 | .084 |
| 3 SMALFFEM | | | | -.098 | | .358 |
| 4 HOMEWORK | -.076 | .059 | -.128 | -.137 | 1.674 | .199 |
| 5 SPORTS | | | | .039 | | .718 |
| 6 XMAWORK | | | | .024 | | .822 |
| 7 ARTHUSIC | | | | -.041 | | .706 |
| 8 MASKUL | | | | -.079 | | .462 |
| 9 STRACAD | -.099 | .068 | -.146 | -.154 | 2.124 | .148 |
| 10 READMATL | | | | -.071 | | .844 |
| 11 MAWORK | | | | .094 | | .382 |
| 13 WTCH | | | | -.058 | | .590 |
| 14 Q21 | | | | -.017 | | .873 |
| 15 Q30 | .321 | .132 | .268 | .251 | 5.939 | .016 |
| 16 Q41 | -.277 | .117 | -.277 | -.245 | 5.617 | .020 |
| 17 Q42 | .315 | .103 | .328 | .310 | 9.326 | .003 |
| 18 Q47 | | | | -.114 | | .286 |
| 19 O55 | | | | -.025 | | .818 |
| 20 TCHMF | | | | -.006 | | .957 |
| 21 TGRDEC | | | | -.015 | | .891 |
| 22 NGR24 | | | | -.011 | | .917 |
| 23 NMAGJ | | | | .065 | | .543 |
| 24 YTCH | | | | .056 | | .604 |
| 25 PONR | | | | -.085 | | .476 |
| 26 POFFR | | | | .023 | | .828 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 9.55831 | 6 | 1.59305 |
| Residuals from Regression | 32.82537 | 88 | .37302 |
| Corrected Total | 42.38369 | 94 | |

F-Ratio = 4.27 with 6 and 88 Deg. Freedom

Significance level of F-Ratio = .0008

from the third to the fourth grade, from the fourth to the fifth grade, and from the third to the fifth grade. Table 6.5 summarizes the results of the stepwise regression procedures and identifies the variables which stepped in (or out) at each stage.

Table 6.2 indicates that five variables entered the final regression equation for gain in reading during fourth grade. They included one teacher variable (4), two student variables (14 and 16), and two home variables (21 and 22). The five variables produced $R = .49$ and together accounted for approximately 20% of the variation in student gain in reading during fourth grade. Although the variance accounted for by the equation was significant at beyond the .001 level, only two of the individual variables were significant at the .05 level, and three were significant at the .10 level. The most potent predictors of gain in reading achievement were variable 4 (the main purpose of education should be to teach people what to think) and variable 14 (percent of time on-task in reading at grade 4). These two variables accounted for approximately 15% of the variance in reading gain.

Table 6.3 provides the final regression equation for gain in reading scaled score from the end of grade 4 to the end of grade 5. The five variables entered; the equation produced $R = .6$ and accounted for approximately 17% of the variance in gain in student reading scores from the end of grade 4 to the end of grade 5. Note that only variable 16 (academic aptitude) appeared in both Table 6.2 and Table 6.3 (but with opposite signs). Of the five variables which entered the equation, three (7, 10, and 13) were teacher-related, one (16) was student-related, and one (23) was home-related. The first two variables entering the equation were 16 (academic attitude) and 10 (whether or not the teacher held a graduate degree), which entered with a negative sign. These two variables accounted for approximately 12% of the variance in gain in reading scores during grade 5. Significance levels for the variables entering the final equation ranged from a low of .002 (10) to a high of .061 (23).

Table 6.4 shows the final regression equation for gain in reading scaled score from the end of grade 3 to the end of grade 5. Student gain scores in any single year tend to vary more widely than they did over the two-year time span, i.e., there is considerable regression to the mean. Using the gain over a two-year period tended to smooth the data. Six variables entered the final regression equation producing $R = .48$ and accounting for approximately 17% of the variance in student gain over the two-year period. One variable (2) was student-related, two (4 and 9) were home-related, and three (15, 16, and 17) were teacher-related. The three teacher-related variables all dealt with the attitudes and beliefs of the teachers. Time spent on homework entered the equation but with a negative sign and a relatively low level of significance.

Table 6.5 summarizes the stepwise regression analyses for gain in reading and shows the step at which each variable entered the equation. Examining the three final regression equations for gain in reading score, it will be noted that only one variable (academic aptitude) entered all three of the final equations, once negatively and twice

TABLE 6.5

Summary of Stepwise Regression of Gains in Reading Standard Scores
on Selected Home, School and Teacher Variables

| <u>Step No.</u> | <u>Variable</u> | <u>In/out</u> | <u>R</u> | <u>R²</u> | <u>Change in R²</u> | <u>Sig. Level</u> |
|----------------------------------|-----------------|---------------|----------|----------------------|------------------------------------|-----------------------|
| <u>Grade 3 - Grade 4 (n=100)</u> | | | | | | |
| 1 | Q30R | In | .276 | .076 | | .006 |
| 2 | PONR2 | In | .386 | .140 | .073 | .005 |
| 3 | ARTMUSIC | In | .430 | .185 | .036 | .043 |
| 4 | MASKUL | In | .460 | .212 | .027 | .074 |
| 5 | ACAPT | In | .486 | .236 | .024 | .085 |
| 6 | Q41R | In | .507 | .257 | .021 | .108 |
| <u>Grade 4 - Grade 5 (n=95)</u> | | | | | | |
| 1 | ACAPT | In | .284 | .081 | | .005 |
| 2 | TGRDEGR | In | .354 | .125 | .044 | .033 |
| 3 | YTCHR2 | In | .394 | .156 | .031 | .076 |
| 4 | Q47R | In | .424 | .180 | .024 | .106 |
| 5 | STRACAD | In | .460 | .211 | .031 | .061 |
| <u>Grade 3 - Grade 5 (n=95)</u> | | | | | | |
| 1 | ACAPT | In | .242 | .058 | | .018 |
| 2 | STRACAD | In | .323 | .104 | .046 | .033 |
| 3 | Q42R | In | .364 | .133 | .029 | .086 |
| 4 | Q30R | In | .399 | .159 | .026 | .096 |
| 5 | Q41R | In | .459 | .211 | .052 | .018 |
| 6 | HOMEWORK | In | .475 | .226 | .015 | .199 |

positively. One variable, Q30, (the main purpose of education should be to teach people what to think) entered two of the three equations, as did the parent's perception of whether or not the school had a strong academic program (STRACAD). Each of the three final regression equations produced $R = .46$ to $.49$, and each accounted for around 20% of the variance in student gains in reading.

Table 6.6 shows the final equation when the gain in student reading scores from the end of grade 3 to the end of grade 5 was regressed on the set of home-related variables alone but with CAI included. Only two variables entered the equation. One was academic aptitude (2); the other was the parent's perception of whether or not the school had a strong academic program (9). The equation produced $R = .32$ and accounted for approximately 8% of the variance in gain in student reading scores from grade 3 to grade 5.

Table 6.7 shows the final regression equation when student gain in reading from grade 3 to grade 5 was regressed on teacher-related variables. (Student academic aptitude was not included in this regression.) Four variables (15, 16, 17, and 18) entered the final equation and all of them reflected aspects of teacher attitudes or beliefs. The equation yielded $R = .45$ and accounted for about 17% of the variance in the gain in reading scaled score from third to fifth grade.

Mathematics

Tables 6.8, 6.9, and 6.10 display the final equations for the regression on gain in mathematics scores from grade 3 to grade 4, from grade 4 to grade 5, and from grade 3 to grade 5. As shown in Table 6.8, six variables were included in the final equation when gain in mathematics from grade 3 to grade 4 was regressed on the home-, school-, and teacher-related variables. Variable 12 (number of magazines and journals read by the teacher) entered the equation at step 4 but was removed at step 8 (see Table 6.11). Of the six variables which entered the final equation, two (3 and 10) were teacher-related. One (17) was student-related, and three (19, 23, and 24) were home-related. The six variables produced $R = .44$ and accounted for approximately 14% of the variance in student gain in mathematics from grade 3 to grade 4. The first two variables entering the equation (student gender and number of sports activities in which the student engaged) accounted for about 10% of the variance in student gain scores.

Only one variable (whether or not the teacher held a graduate degree) entered the equation for gain in mathematics scaled score from grade 4 to grade 5 (see Table 6.9). As was the case with reading, this variable entered with a negative sign. Its correlation with student gain score was $-.26$, and it accounted for about 5% of the variation in mathematics gain from grade 4 to grade 5.

The teacher's graduate-degree status also was the only variable to enter the equation for mathematics gain from grade 3 to grade 5,

TABLE 6.6

Regression of Student Gain in Reading Scaled Score, Grade 3-5, on Home Variables

Multiple Correlation Coefficient..... .3228
 Coefficient of Determination..... .1042
 Corrected Coefficient of Determination..... .0847

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 92 Deg. Freedom | Sig. Level |
|-------------|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Constant | -.097 | .066 | | -.151 | 2.148 | .146 |
| 2 ACAPT | .156 | .068 | .227 | .233 | 5.296 | .023 |
| 3 SMALEFEM | | | | -.114 | | .276 |
| 4 HOMEWORK | | | | -.127 | | .275 |
| 5 SPORTS | | | | .081 | | .441 |
| 6 XMAWORK | | | | -.063 | | .545 |
| 7 ARTMUSIC | | | | .007 | | .945 |
| 8 MASKUL | | | | -.103 | | .325 |
| 9 STRACAD | -.145 | .066 | -.214 | -.220 | 4.695 | .032 |
| 10 READMATL | | | | -.018 | | .867 |
| 11 MAWORK | | | | .042 | | .688 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 4.41668 | 2 | 2.20834 |
| Residuals from Regression | 37.96700 | 92 | .41268 |
| Corrected Total | 42.38368 | 94 | |

F-Ratio = 5.35 with 2 and 92 Deg. Freedom
 Significance Level of F-Ratio = .0063

TABLE 6.7

Regression of Student Gain in Reading Scaled Score, Grade 3-5, on School and Teacher Variables

| Variable | Regression Coefficient | Std. Error or Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 90 Deg. Freedom | Sig. Level |
|---|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Multiple Correlation Coefficient..... | | | | | .4541 | |
| Coefficient of Determination..... | | | | | .2062 | |
| Corrected Coefficient of Determination..... | | | | | .1710 | |
| Constant | -.114 | .067 | | -.177 | 2.902 | .091 |
| 13 WTCH | | | | -.047 | | .660 |
| 14 Q21 | | | | -.051 | | .629 |
| 15 Q30 | .394 | .127 | .329 | .310 | 9.552 | .002 |
| 16 Q41 | -.250 | .116 | -.245 | -.221 | 4.637 | .033 |
| 17 Q42 | .390 | .101 | .405 | .376 | 14.786 | .000 |
| 18 Q47 | -.159 | .070 | -.229 | -.231 | 5.074 | .026 |
| 19 Q55 | | | | -.053 | | .617 |
| 20 TCHMF | | | | -.018 | | .861 |
| 21 TGRDEG | | | | .005 | | .964 |
| 22 NGR24 | | | | .052 | | .621 |
| 23 NMAGJ | | | | .008 | | .938 |
| 24 TYCH | | | | -.057 | | .589 |
| 25 PONR | | | | -.103 | | .333 |
| 26 POFFR | | | | .003 | | .974 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 8.74103 | 4 | 2.18526 |
| Residuals From Regression | 33.64265 | 90 | .37381 |
| Corrected Total | 42.38368 | 94 | |

F-Ratio = 5.85 with 4 and 90 Deg. Freedom
 Significance Level of F-Ratio = .0003

TABLE 6.8

Regression of Student Gain in Mathematics Scaled Score, Grade 3-4, on Home, School, and Teacher Variables

Multiple Correlation Coefficient..... .4408
 Coefficient of Determination..... .1943
 Corrected Coefficient of Determination..... .1423

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 93 Deg. Freedom | Sig. Level |
|-------------|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Constant | -.202 | .053 | | -.365 | 14.302 | .000 |
| 2 WTCH | | | | .022 | | .832 |
| 3 Q21 | -.180 | .079 | -.328 | -.229 | 5.167 | .025 |
| 4 Q30 | | | | -.072 | | .831 |
| 5 Q41 | | | | .119 | | .252 |
| 6 Q42 | | | | .113 | | .276 |
| 7 Q47 | | | | -.008 | | .938 |
| 8 Q55 | | | | .087 | | .401 |
| 9 TCHMF | | | | .097 | | .353 |
| 10 TGRDEG | .166 | .080 | .296 | .210 | 4.286 | .041 |
| 11 NGR24 | | | | -.109 | | .295 |
| 12 NMACJ | | | | -.113 | | .277 |
| 13 YTCH | | | | .075 | | .469 |
| 14 PONM | | | | .042 | | .687 |
| 15 POFFM | | | | -.053 | | .614 |
| 16 ACAPT | | | | .021 | | .840 |
| 17 SMALFEM | .105 | .058 | .185 | .183 | 3.233 | .075 |
| 18 HOMEWORK | | | | -.088 | | .396 |
| 19 SPORTS | -.136 | .065 | -.218 | -.212 | 4.367 | .039 |
| 20 XMAWORK | | | | .004 | | .968 |
| 21 ARTMUSIC | | | | -.003 | | .978 |
| 22 MASKUL | | | | -.098 | | .349 |
| 23 STRACAD | .076 | .055 | .135 | .140 | 1.861 | .175 |
| 24 READMATL | .098 | .057 | .165 | .173 | 2.863 | .094 |
| 25 MAWORK | | | | .031 | | .767 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 6.29540 | 6 | 1.04923 |
| Residuals From Regression | 26.10950 | 93 | .28075 |
| Corrected Total | 32.40489 | 99 | |

F-Ratio = 3.74 with 6 and 93 Deg. Freedom
 Significance Level of F-Ratio = .0022

TABLE 6.9

Regression of Student Gain in Mathematics Scaled Score, Grade 4-5, on Home, School, and Teacher Variables

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 94 Deg. Freedom | Sig. Level |
|---|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Multiple Correlation Coefficient..... | | | | | | .2565 |
| Coefficient of Determination..... | | | | | | .0658 |
| Corrected Coefficient of Determination..... | | | | | | .0522 |
| Constant | .125 | .053 | | .274 | 5.581 | .021 |
| 2 WTCH | | | | .071 | | .561 |
| 3 Q21 | | | | .009 | | .939 |
| 4 Q30 | | | | .047 | | .696 |
| 5 Q41 | | | | .091 | | .453 |
| 6 Q42 | | | | .092 | | .449 |
| 7 Q47 | | | | .088 | | .467 |
| 8 Q55 | | | | -.001 | | .991 |
| 9 TCHMF | | | | .073 | | .546 |
| 10 TGRDEG | -.123 | .055 | -.256 | -.256 | 4.857 | .030 |
| 11 NGR24 | | | | -.060 | | .622 |
| 12 NMAGJ | | | | .027 | | .822 |
| 13 YTCH | | | | .022 | | .853 |
| 14 PONM | | | | -.120 | | .322 |
| 15 POFFM | | | | .095 | | .434 |
| 16 ACAPT | | | | .098 | | .421 |
| 17 SMALEFEM | | | | -.105 | | .387 |
| 18 HOMEWORK | | | | .139 | | .249 |
| 19 SPORTS | | | | .133 | | .272 |
| 20 XMAWORK | | | | .056 | | .642 |
| 21 ARTMUSIC | | | | .052 | | .669 |
| 22 MASKUL | | | | -.079 | | .516 |
| 23 STRACAD | | | | .049 | | .685 |
| 24 READMATL | | | | .073 | | .550 |
| 25 MA'ORK | | | | .090 | | .458 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | .96485 | 1 | .96485 |
| Residuals from Regression | 13.70564 | 69 | .19863 |
| Corrected Total | 14.67049 | 70 | |

F-Ratio = 4.86 with 1 and 69 Deg. Freedom
Significance Level of F-Ratio = .0309

and it entered with a negative sign (see Table 6.10). For the gain from grade 3 to grade 5, the correlation was $-.33$, accounting for approximately 10% of the variance in student gain in mathematics from grade 3 to grade 5. Coding of the variable was such that holding a graduate degree affected students' gain negatively. Table 6.11 provides a summary of the final regression equations for gain in mathematics scaled scores.

Table 6.12 shows that, when mathematics gain from grade 3 to grade 5 was regressed only on the home-related variables (including academic aptitude), the one variable to enter the equation was the number of sports activities in which the student was involved. The correlation of sports activities with mathematics gain was $.17$, and it accounted for less than 2% of the variance in student gain in mathematics during the period from the end of grade 3 to the end of grade 5.

Table 6.13 shows that only one variable, the teacher's graduate-degree status, entered the equation when gain in mathematics from grade 3 to grade 5, was regressed on school- and teacher-related variables with cognitive aptitude excluded. The variable entered with a negative sign ($-.33$) and accounted for about 10% of the variance in mathematics gain from grade 3 to grade 5.

Discussion

One must be quite cautious in discussing the results reported in this section. It must be noted that the data were drawn from only four elementary schools. Furthermore, these schools served middle- and lower middle-class families, predominantly white, located in small or medium-sized cities in one state in the upper Midwest. Thus, the sample of students involved in the present study differs markedly from the studies in which samples were drawn from inner-city schools.

It also must be noted that gain in student achievement is "slippery" and difficult to measure. The availability of student gains over a two-year period served to smooth the data by permitting regression to the mean to exert its influence. Thus, we feel somewhat more comfortable with the equations measuring gain over the two-year period from grade 3 to grade 5.

A further word of caution is in order concerning the teacher-related variables. The number of teachers who taught either reading or mathematics to the students in the sample during any one year was quite small, typically 10 to 15, which in itself suggests caution. The procedures used in constructing the teacher-student dyads resulted in some teachers being weighted more heavily than others, e.g., a teacher who taught 15 students would appear three times as often as one who taught 5 students, a factor which may have introduced some bias. The decision criteria applied in constructing the teacher-student dyads also may have inadvertently biased the sample.

TABLE 6.10

Regression of Students Gain in Mathematics Scaled Score, Grade 3-5, on Home, School and Teacher Variables

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 69 Deg. Freedom | Sig. Level |
|---|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Multiple Correlation Coefficient..... | | | | | .3321 | |
| Coefficient of Determination..... | | | | | .1103 | |
| Corrected Coefficient of Determination..... | | | | | .0974 | |
| Constant | .513 | .132 | | .423 | 14.994 | .000 |
| 2 ACAPT | | | | .105 | | .385 |
| 3 SMALFFEM | | | | -.077 | | .524 |
| 4 HOMEWORK | | | | .145 | | .229 |
| 5 SPORTS | | | | .070 | | .566 |
| 6 XMAWORK | | | | .088 | | .470 |
| 7 ARTMUSIC | | | | .076 | | .530 |
| 8 MASKUL | | | | -.059 | | .628 |
| 9 STRACAD | | | | .007 | | .956 |
| 10 READMATL | | | | .051 | | .677 |
| 11 MAWORK | | | | .139 | | .249 |
| 13 WTCH | | | | .024 | | .846 |
| 14 Q21 | | | | .076 | | .531 |
| 15 Q30 | | | | .049 | | .685 |
| 16 Q41 | | | | .036 | | .770 |
| 17 Q42 | | | | .088 | | .469 |
| 18 Q47 | | | | -.046 | | .702 |
| 19 Q55 | | | | -.090 | | .459 |
| 20 TCHMF | | | | -.033 | | .788 |
| 21 TGRDEG | -.722 | .247 | -.332 | -.332 | 8 53 | .004 |
| 22 NGR24 | | | | .080 | | .509 |
| 23 NMAGJ | | | | -.086 | | .476 |
| 24 YTCH | | | | -.059 | | .625 |
| 25 PONM | | | | -.132 | | .277 |
| 26 POFFM | | | | .134 | | .270 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 1.69378 | 1 | 1.69378 |
| Residuals from Regression | 13.66389 | 69 | .19803 |
| Corrected Total | 15.35767 | 70 | |

F-Ratio = 8.55 with 1 and 69 Deg. Freedom
Significance Level of F-Ratio = .0047

TABLE 6.11

Summary of Stepwise Regression of Gain in Mathematics Scaled Scores
on Selected Home-School-and Teacher-Related Variables

| <u>Step No.</u> | <u>Variable</u> | <u>In/out</u> | <u>R</u> | <u>R²</u> | <u>Change in R²</u> | <u>Sig. Level</u> |
|----------------------------------|-----------------|---------------|----------|----------------------|------------------------------------|-----------------------|
| <u>Grade 3 - Grade 4 (n=100)</u> | | | | | | |
| <u>All Variables</u> | | | | | | |
| 1 | SMALEFEM | In | .273 | .074 | .074 | .006 |
| 2 | SPORTS | In | .320 | .103 | .029 | .084 |
| 3 | STRACAD | In | .365 | .133 | .030 | .069 |
| 4 | NMAGJ | In | .391 | .153 | .020 | .139 |
| 5 | READMATL | In | .411 | .169 | .016 | .182 |
| 6 | Q21M | In | .432 | .186 | .017 | .159 |
| 7 | TGRDEG | In | .452 | .205 | .019 | .151 |
| 8 | NMAGJ | Out | .441 | .194 | -.011 | .277 |
| <u>Grade 4 - Grade 5 (n=71)</u> | | | | | | |
| 1 | TGRDEG | In | .257 | .066 | .052 | .031 |
| <u>Grade 3 - Grade 5 (n=71)</u> | | | | | | |
| 1 | TGRDEG | In | -.332 | .097 | .097 | .005 |

TABLE 6.12

Regression of Student Gain in Mathematics Scaled Score, Grade 3-5, on Home Variables

Multiple Correlation Coefficient..... .1744
 Coefficient of Determination..... .0304
 Corrected Coefficient of Determination..... .0164

| Variable | Regression Coefficient | Std. Error of Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 69 Deg. Freedom | Sig. Level |
|-------------|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Constant | .156 | .055 | | .323 | 8.012 | .006 |
| 2 ACAPT | | | | .049 | | .688 |
| 3 SMAIFFEM | | | | -.078 | | .523 |
| 4 HOMEWORK | | | | .143 | | .236 |
| 5 SPORTS | .085 | .057 | .174 | .174 | 2.165 | .145 |
| 6 XMAWORK | | | | .106 | | .380 |
| 7 ARTMUSIC | | | | .033 | | .788 |
| 8 MASKUL | | | | -.057 | | .669 |
| 9 STRACAD | | | | .020 | | .868 |
| 10 READMATL | | | | .038 | | .754 |
| 11 MAWORK | | | | .128 | | .292 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Squares | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | .46722 | 1 | .46722 |
| Residuals from Regression | 14.89044 | 69 | .21580 |
| Corrected Total | 15.35767 | 70 | |

F-Ratio = 2.17 with 1 and 69 Deg. Freedom
 Significance Level of F-Ratio = .1457

TABLE 6.13

Regression of Student Gain in Mathematics Scaled Score, Grade 3-5, on School and Teacher Variables

| Variable | Regression Coefficient | Std. Error or Regression Coefficient | Standardized Regression Coefficient | Partial Correlation Coefficient | Partial F Value With 1 and 69 Deg. Freedom | Sig. Level |
|------------|------------------------|--------------------------------------|-------------------------------------|---------------------------------|--|------------|
| Constant | .513 | .132 | | .423 | 14.994 | .000 |
| 13 WTCHM | | | | .024 | | .846 |
| 14 Q21M | | | | .076 | | .531 |
| 15 Q30M | | | | .049 | | .685 |
| 16 Q41M | | | | .036 | | .770 |
| 17 Q42M | | | | .088 | | .469 |
| 18 Q47M | | | | -.046 | | .702 |
| 19 Q55M | | | | -.090 | | .459 |
| 20 TCHMFM | | | | -.033 | | .788 |
| 21 TGRDEGM | -.722 | .247 | -.332 | -.332 | 8.553 | .004 |
| 22 NGR24M | | | | .080 | | .509 |
| 23 NMAGJM | | | | -.086 | | .476 |
| 24 YTCHM | | | | -.059 | | .625 |
| 25 PONM | | | | -.132 | | .277 |
| 26 POFFM | | | | .134 | | .270 |

Analysis of Variance Summary Table

| Source of Variation | Sum of Sources | Deg. Freedom | Mean Square |
|---------------------------|----------------|--------------|-------------|
| Linear Regression | 1.69378 | 1 | 1.69378 |
| Residuals from Regression | 13.66389 | 69 | .19803 |
| Corrected Total | 15.35767 | 70 | |

F-Ratio = 8.55 with 1 and 69 Deg. Freedom
 Significance Level of F-Ratio = .0047

6.19

It is noteworthy that none of the regression equations specified in these analyses produced large R s. In no instance was R greater than .50, and in no instance was more than 25% of the variation in student gain accounted for by the variables included in the equation. Although they were carefully selected from a much larger universe of variables in each area (home, school, and teacher), the variables included in these equations were not particularly useful in explaining variance in student gains.

The student's academic aptitude, as expected, entered the equations for gain in reading scores from grade 3 to grade 4, grade 4 to grade 5, and grade 3 to grade 5. However, academic aptitude did not account for more than 8% of the variance in any of the three equations. This variable was rather unstable, both with regard to its partial correlation with gain in reading score and with regard to the sign with which it entered the equation. Academic aptitude did not enter any of the three equations for gain in mathematics. This finding was unexpected, and no ready explanation for the lack of a significant relationship between student academic aptitude and gain in mathematics is immediately evident.

The dichotomous variable indicating the teacher's graduate-degree status entered negatively for two of the reading regressions (grade 4-5 and grade 3-5). This variable also entered each of the mathematics gain equations, entering with a positive sign for gain from grade 3-4, and with a negative sign for gain from grade 4-5 and grade 3-5. Taken at face value, this finding lends little support to those who advocate graduate work for teachers in the elementary grades. However, one may not conclude on the basis of these findings that teachers who hold a graduate degree are less effective in teaching reading or mathematics than those who hold only a bachelor's degree. In some instances, teachers with an advanced degree taught less able students who did not score well on the standardized test. In addition, our data do not include information concerning the course of study for the advanced degree. Thus, teachers might have pursued their graduate work in a field unrelated to the teaching of either reading or mathematics and, of course, the sample of teachers is small. This finding does raise a question about the cost effectiveness of paying teachers additional salary for earning graduate credits. In this regard, one may observe that the number of graduate credits the teacher had completed in the past 24 months did not enter any of the regressions.

It also is of interest to note that time on-task entered only one equation (reading grade 3-4), and that percentage of time off-task did not enter any of the regression equations. Although in earlier analyses we had found that time on-task was a useful predictor of the student's achievement test score (Rossmiller, 1983), time on-task was not a significant predictor of the gain in achievement in either reading or mathematics. Although this finding does not imply that time on-task is unimportant, it does indicate that increasing the amount of time on-task is not a panacea that will produce marked improvements in student gain in reading or mathematics.

When only the home-related variables were regressed against student gain in reading from grade 3 to grade 5, just one variable (the parents'

perception of whether or not the school had a strong academic program) entered the equation at a statistically significant level. The amount of variance it accounted for, however, was negligible. Only the student's involvement in sports was correlated significantly with gain in mathematics from grade 3-5. Again, the amount of variance explained by this home-related variable was slight.

One is tempted to conclude on the basis of these data that home-related variables exerted relatively little influence over a student's gain in reading or mathematics score from grade 3-5. Among the variables that failed to enter the equation, for example, were amount of time spent daily on homework, involvement in art and music activities, the mother's years of school completed, the amount of reading material in the home, and the number of hours per week the mother worked outside the home.

Analysis using only school- and teacher-related variables provided somewhat different results for reading and mathematics. Four variables which measured aspects of teachers' attitudes and beliefs entered the equation for gain in reading from grade 3-5, and they accounted for approximately 17% of the variance in student gain in reading. In mathematics, however, only one variable (the teacher's graduate-degree status) entered the equation (negatively). The school- and teacher-related variables did not account for more than 10% of the variance in gain in mathematics from grade 3-5.

In summary, the variables included in the analyses reported in this section were not particularly helpful in understanding the gain in scaled scores made by students in reading and mathematics from grade 3 to grade 5. The results further emphasize the complexity of human learning and the uniqueness of individual learners. Time on-task in reading or in mathematics was not a potent predictor of student gain. Time spent on homework was not a significant predictor of student gain. Students of teachers who held a graduate degree did less well than students whose teachers did not have a graduate degree. Teachers' attitudes and beliefs were at least as important as other, more easily quantifiable, characteristics of teachers. And the student's academic aptitude, although a useful predictor of student gain, was not as potent a predictor of student gain in reading and mathematics as might be expected.

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SECTION VI7

OBSERVATIONS AND REFLECTIONS

Findings and conclusions derived from the analyses of the rather extensive data base developed in this study have been stated in preceding sections and will not be reiterated here. Rather, we shall offer some general observations and reflect on the meaning which might be attached to our findings.

Concerning the Sample

The elementary school students who comprised the sample for this study differed in many ways from the samples used by other researchers who have sought to specify educational production functions. The students we studied did not live in large metropolitan centers; they lived in either rural/small town school districts or school districts in medium-sized cities in Wisconsin. Most of the students were white and were from middle- or lower middle-class families. The families tended to be small to medium in size; very few had less than two or more than five children. All but nine of the students lived at home with their natural mothers, and all 198 lived in a home in which an adult female was present. All but 29 lived with their natural fathers and only nine students lived in homes in which there was no adult male present. Only 4% of the students and parents in this study were not white, and none used a primary language other than English. Thus it is evident that this sample of students was quite dissimilar when compared to the samples comprised of minority, disadvantaged, or at-risk children which other researchers have used.

Although one must be cautious in generalizing from the results of a study of students in four schools, it nevertheless appears that the students involved were similar in many respects to the students typically found in rural, small town or small city school districts located in the upper Midwest, or even in other regions of the United States.

Concerning Equity and Efficiency

Two major questions were posed at the outset of this study. One dealt with equity in the use of school resources; the other dealt with efficiency in the use of school resources. With regard to the question of equity, students in Title I or P.L. 94-142 programs ("special students") were the recipients of more time and other school resources than regular students. Whether this practice satisfies the criterion of equity, of course, depends upon how that criterion is defined operationally.

Some argue that equity is best served when children who are disadvantaged by social, economic, or other handicapping conditions are provided with the additional resources necessary for them to achieve at least minimal progress in school. Authorities in educational finance (and courts that have examined the issue), for example, are in general agreement that merely spending an identical amount of money on every student does not satisfy the equity criterion. Rather, they argue that the resources which are provided should be tailored to meet the individual needs of the student even if this means substantial differences in the level of resources provided to individual students.

On the other hand, some argue that, because resources are limited, it is unfair to divert more of them to the education of handicapped children. The assumption underlying this argument is that the rules of a zero-sum game apply; in order for some students to gain, others must lose. So long as additional resources are provided to meet the special needs of handicapped children, this argument has little merit. However, to the extent that resources for education are constrained by local, state, and national decisionmakers, the zero-sum game analogy is appropriate.

The four schools we studied appear to have taken seriously the incentives, and indeed the legal requirement, that they develop appropriate, individualized programs to meet the special needs of handicapped and disadvantaged students. Whether the needs of such students are being served at the expense of meeting the needs of regular students cannot be determined from our data. However, when special students were excluded from the sample, the range of expenditure per pupil was narrowed markedly, and within the population of regular students we found no evidence of inequity in access to resources.

With regard to efficiency, the results of this study provide no firm basis for conclusions concerning whether resources were being used efficiently. We observed very little variation in instructional practice, at least in terms of the modes of instruction that were employed, and we did not find that the percentage of time spent in a particular instructional mode was consistently associated with student achievement in reading or mathematics. We did note, however, that some teachers were much more successful than others in keeping their students on task. Although these four schools each professed a commitment to individualized instruction, they did not make extensive use of either small-group instruction or of the teacher working with an individual student. Large-group instruction and independent work (typically seat-work) were by far the predominate modes of instruction. With the exception of one school, little overt attention was directed toward individualizing instruction for regular students, particularly when their programs of study were compared with those of special students.

Our observations in these four schools illustrate very clearly the trade-offs between efficiency and equity. One could argue, for example, that the criterion of efficiency would be served far better by directing additional resources to the most able students because, in the short run, they are more likely to show rapid gains in achievement and, in the long run, to make the greatest contributions to the social, economic,

and political life of their communities. However, equity considerations, as they are embodied in fiscal incentives and legal requirements, lead to an emphasis on programs for handicapped or disadvantaged students which, in a time of constrained resources, are likely to come at the expense of regular students and gifted or talented students. We offer no solutions to this dilemma, but it is difficult to see how it can be avoided in the real world of teachers and administrators.

Time on-task was a much more potent predictor of achievement for low-ability students than for high-ability students. The percentage of time on-task accounted for a great deal of the variance in achievement test scores of students in the lowest quartile but, for students in the highest quartile, the percentage of time on-task made little difference in achievement. Students in the highest quartile typically finished their lessons rapidly and thus had less reason to be on-task than students in the lowest quartile. The intriguing question is whether more challenging and creative assignments for the high-quartile students would have increased both their time on-task and their achievement test scores. Perhaps the lack of a strong association between percentage of time on-task and achievement scores for high-ability students simply reflects the fact that too frequently they were not challenged to make full use of their talents in the elementary schools in our sample.

Concerning the Conceptual Framework

The conceptual framework discussed in Section I (see Figure 1.1) proved useful in organizing the collection and analysis of data. The small sample of schools limited the extent to which we could investigate the external environment of the school and its impact on student learning. Our primary data concerning the external environment was gained from interviews with parents. Data from the parental interviews were used to construct a socioeconomic status index for each family. As described in Section IV, the family's socioeconomic status was positively linked with both student achievement and growth in achievement, and the strength of the linkage appeared to increase as the students progressed through school. We think, however, that it was not income per se that was the critical element in the home environment. Rather, it was the atmosphere in the homes of higher socioeconomic status families that made the difference--the attitude toward education, the expectations held for the child, and the provision of supplemental educational activity. In short, our data show that the external environment does affect student achievement and growth in academic subjects. While these variables are not susceptible to control by school personnel, the relationships identified in this study underline the importance of cooperative, supportive working relationships between the home and the school.

With regard to resource inputs, when special students were removed from the sample the variation in resources provided to individual students was remarkably small, and no significant relationship was found between the cost of the resources flowing to individual students and

student achievement. Our data suggest that the differences in teacher time and physical resources provided for regular students in these schools were quite small and did not contribute significantly to variance in student achievement.

Our data highlight the importance of viewing the student as a very significant human resource input rather than as merely a passive recipient of services. The student's cognitive aptitude index consistently accounted for more of the variance in student achievement scores than any other variable we examined. It also made a significant (although smaller) contribution to explanation of variance in student gain in reading and mathematics scores. Thus, early childhood and preschool programs which serve to enhance the child's cognitive aptitude and skills are supported by the results of this study.

We also obtained extensive data about a second major human resource, the teacher. Our results suggest that the attitudes and beliefs of teachers, as measured by the instrument we developed, were considerably more useful than more easily quantified variables (age, years of experience, graduate-degree status, etc.) in accounting for variance in student achievement. Our results indicate that, next to the student, the teacher is the most important element in the educational process. Teacher-related variables accounted for a substantial amount of the variation in student achievement scores, even when the affects of the student's cognitive aptitude were partialled out. Although we must be cautious in our generalizations because our sample of teachers in any given year was small, the results underline the importance of the teacher's influence on student achievement.

With regard to the way resources are used in the educational process, our primary data source was the use of time in classroom. Two findings concerning the use of time bear repeating. First, merely increasing the percentage of time students are on-task will not, by itself, remedy low student achievement. The percentage of time on-task, while related to student achievement, did not account for much of the variation in student achievement, although it did appear to be more important for low-ability students than for high-ability students. Unfortunately, our commitments to the participating teachers precluded us from gathering data concerning the quality of instruction in the classes we observed. We know, however, that the quality of instruction varied, and we believe the quality of instruction is at least as important as the amount of time on-task in its effect on student achievement. Second, although the school day actually lengthened between third and fifth grade, the amount of class time actually devoted to the study of the five basic academic subjects (reading, mathematics, science, language arts and social studies) declined an average of nearly one hour per day between third and fifth grade. Other activities increasingly cut into the amount of time available for academic subjects. Although these other activities may be important, the reduction in the amount of class time devoted to basic academic subjects is cause for concern.

With regard to outputs, we were able to obtain only short range measures of the outcomes of the educational process. We relied on

standardized achievement tests in reading and mathematics for our measures of student achievement and the Self-Observations Scales for our information concerning affective development. We are aware of the limitations of these instruments but, nevertheless, must note that we found no significant relationship between the students' affective development and their achievement in reading and mathematics.

The results of this study underline the complexity of the educational process and the difficulty of attempting to understand student achievement and growth based only on the events that occur in school. Although our unit of analysis was the individual pupil, thus avoiding some of the problems encountered by previous researchers who had to rely on school- or district-level data, we were not able to account for a large amount of the variance in either student achievement or growth. Our results suggest that the search for a single education production function is futile. Rather, we believe that there are many education production functions, i.e., that the most efficient and effective combination of resources will be a function of the specific student as well as many situational variables. Perhaps this is why the teacher is such an important element in the educational process. It is classroom teachers who must make day-to-day, hour-to-hour, and even minute-to-minute decisions about how to use most effectively the resources available to optimize learning for the students in their classrooms. Thus, they are the ultimate managers of the resources society allocates for the education of the young.

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APPENDIX

Abstracts of Doctoral Dissertations Completed
by Research Assistants

The Allocation of Instructional Time to Students in
Elementary Schools That Seek To Individualize Instruction

Shirley Mae Broaden

(ERIC Document Reproduction Service No. ED 193 229)

The purposes of this study were: (1) to investigate academic ability grouping of students and the amount of time they received from teachers; (2) to examine the effects of academic ability grouping on students' self-concept; and (3) to determine the effect on student academic ability group placement of teachers' perceptions of students' social behavior.

Data on 48 third grade students and four teachers were collected in four Wisconsin elementary schools. Six instruments were used to gather data and information concerning students, teachers, and grouping procedures. Four major hypotheses and ancillary questions were analyzed statistically. The probability level for all tests of significance was set at .05.

The major conclusions were:

1. A statistically significant difference existed between students' academic ability group level and the amount of instructional time students received from teachers in a small-group and in a combination of one-to-one and small-group arrangement, with low-ability students receiving more of the teacher's time.

2. Nine of 15 student social behavior characteristics were statistically significant when related to the placement of students in academic ability groups, with students in the higher-ability group being rated more favorably on these characteristics.

3. No statistically significant difference was found between students' academic group placement and students' self-concept scores.

4. Regression of students' social characteristics and students' self-concept scores against teacher instructional time allocation in a small group and in a combination of one-to-one and small-group instruction revealed no statistically significant relationship.

5. A statistically significant relationship was found between the amount of time students spent working independently and their academic ability level, with students in the higher-ability group spending more time working independently.

6. No statistically significant relationship was found between the amount of time students were off-task and their social maturity level, between the amount of time students were on-task and their affiliation with the teacher, or between the amount of time students were involved in process behavior and their academic ability level.

The Relationship Between Teacher Job Satisfaction
And Student Reading Achievement, Time Off-Task,

And Teacher Planning Time

Arnold Frank

Dissertation Abstracts International, 44, 339A
(University Microfilms No. 83-04,937)

The purpose of this study was to examine the relationship of several facets of teacher satisfaction to student achievement, student use of time, and teacher planning time. The theoretical framework for this study was based on previous research involving (1) theories of satisfaction and performance, (2) teacher satisfaction literature, and (3) teacher satisfaction and student achievement research.

Four sets of data were collected on 30 classroom teachers and approximately 200 students from four Wisconsin elementary schools during the 1979-80, 1980-81, and 1981-82 school years. Teacher satisfaction data were collected using the Purdue Teacher Opinionnaire. Other data included reading achievement scores, teacher time allocations, and classroom observations of student use of time. The hypotheses were tested using either the Pearson product-moment or the Spearman rank correlations tests, with a .05 level of statistical significance.

The major findings and conclusions were:

1. There was no relationship between student reading achievement and the ten facets of teacher satisfaction investigated in this study.
2. A significant positive correlation existed between teacher satisfaction with community pressures and teacher weekend planning time.
3. Several significant positive correlations were found between the ten teacher satisfaction facets and student use of time in reading classes, the most important being between satisfaction with teaching and amount of one-to-one instruction, satisfaction with principal and amount of process time, and satisfaction with salary and amount of large-group instruction in reading classes.

The Relationship of Individual Student Time Allocation
To Reading and Mathematics Achievement

Kerry Ray Jacobson

(ERIC Document Reproduction Service No. 196 906)

The major purposes of this study were: (1) to determine whether there were differences in student use of time in elementary schools; (2) to determine whether students who spend more time in reading and mathematics classes exhibit greater gains in reading and mathematics achievement; and (3) to determine whether there are "quality" measures of time which are related to achievement gains. It was hypothesized that the ways in which individual students utilized time would be related significantly to their achievement gains. Students were stratified by several background variables to determine the relationship of background characteristics to time allocation measures.

Data were collected on 200 third grade students at three elementary schools in Wisconsin. Time utilization data included classroom observations at three separate periods during the 1979-80 school year. Achievement gains were determined from pre- and post-tests. One-way analyses of variance were used to determine the relationships between background characteristics and time allocation measures. Pearson product-moment correlations were calculated to test the major hypotheses.

The major findings and conclusions follow.

1. Significant differences existed in the amount of time available to individual students in reading and mathematics classes, and the amount of time allocated to reading and mathematics varied significantly by school.

2. Students with greater amounts of allocated time exhibited significantly greater achievement gains in mathematics, and nonspecial students with greater amounts of time on-task exhibited significantly greater achievement gains in mathematics.

3. Individual students varied widely in their time-on-task rates in reading and mathematics, and these rates were significantly related to the student's school, teacher, and ability level.

4. Lower-ability level students received significantly more teacher time in reading than did either high- or medium-ability level students. Medium-ability students received more teacher time than did high-ability students.

5. Students with greater amounts of weighted teacher time exhibited less achievement gain in mathematics.

The Use and Understanding of School Time by Third Graders:
An Ethnographic Case Study

Anna Marie Hassenpflug

(ERIC Document Reproduction Service No. ED 203-906)

The major purposes of this study were to determine how individual third graders use and understand school time, to ascertain what relationships exist between their use and perception of school time, and to generate conclusions about third graders' use and understanding of school time that would be relevant for educational administrators and teachers in allocating school time as an educational resource.

Data for the study were gathered from observations, interviews, and school records of 43 third graders in two ability-grouped units at one school. Both qualitative and quantitative methods were used in analyzing the data.

Decisions regarding time allocation were made at three levels: district, school/unit, and classroom. Subjects offered, their daily order of occurrence, and the allocation of time to specific instructional and non-instructional activities varied between the primary (lower ability) and intermediate (higher ability) units. Non-instructional time accounted for nearly one-third of the total time available in the school week.

Despite substantial variations in the time actually allocated a subject each day, most students received at least 80% of the scheduled instructional time in each subject. Approximately three-fourths of the class time was devoted to instructional activities and one-fourth to non-instructional activities.

There were only two ways--off-task behavior and absence--in which a third grader could control the allotted time during the school day. The mean percentage of off-task time for third graders was relatively low and was greater in academic subjects than in special subjects (art, music, etc.).

Neither the order and names of months nor the precise length of the school year were fixed in the minds of these third graders. There was a substantial difference in the accuracy with which third graders could describe their daily schedules, and most could not give the specific times when various classes began and ended.

Third graders believed they worked at about the same speed as their friends. The most popular children in each unit had achievement and IQ test scores that were close to or below the mean for third graders, and their off-task time approximated the mean for their unit.

The Relationship Between Professional Development
of Teachers and Student Time-on-Task

Peter Waterman Lisi

Dissertation Abstracts International, 43, 1372A
(University Microfilms No. 83-16,252)

The purposes of this study were twofold: (1) to determine whether students whose teachers possess a higher level of professional development exhibit greater time on-task in reading than students whose teachers exhibit a lower level of professional development; and (2) to determine if any specific aspects of teachers' professional development were related to a significantly greater amount of time on-task in reading on the part of students. The major hypothesis was:

- H₁ There is no statistically significant relationship between the amount of time on-task in reading displayed by students, and various aspects of teachers' professional development.

Two instruments were used to collect data on 35 classroom teachers and 200 students in four Wisconsin elementary schools. Data describing teachers' professional development were supplied by teachers on a personal data form. Student time on-task data were collected by conducting individual student observations at periodic intervals during the school year. The data were collected during the 1979-80, 1980-81, and 1981-82 school years as part of the School Resource Utilization Project of the Wisconsin Center for Education Research. The hypothesis was tested using stepwise multiple regression analyses with the level of statistical significance set at .05.

The major findings and conclusions were:

1. There was no relationship between average student time on-task in reading and four of the five aspects of teachers' professional development investigated in this study.
2. One variable, possession of a Master's degree, was negatively associated with student time on-task at a statistically significant level.
3. A significant negative correlation was found between years of teaching experience and student time on-task, suggesting that as teachers acquire additional teaching experience, their students exhibit a decrease in time on-task in reading.

The Relationship of Student Self-Concept to Achievement in
Reading and Mathematics and Time Off-Task

Michael Kemp Martin

Dissertation Abstracts International, 43, 2232A
(University Microfilms No. 82-16,254)

The purpose of this study was to examine the relationship of student self-concept to student use of time and academic achievement in reading and mathematics over a two-year period. Data were collected on 204 students in four Wisconsin elementary schools. Students were observed during their third- and fourth-grade years by a research team. Four sets of data were collected: student self-concept scores, reading and mathematics achievement scores, and classroom observations of student time spent off-task.

The research question was stated in the form of three hypotheses. Each hypothesis was analyzed statistically using a stepwise multiple regression technique. The probability level for all tests of statistical significance was set at .05.

Findings and conclusions derived from the analysis of the data included:

1. The regression of students' change in self-concept scores against change in their reading achievement scores revealed a statistically significant relationship, with two variables--teacher affiliation and social maturity--exhibiting a significant relationship with change in reading achievement in the final equation.

2. A statistically significant relationship was established between change in student self-concept and change in student mathematics achievement scores, with teacher affiliation and social maturity again emerging as statistically significant variables in the final regression equation.

3. No statistically significant relationship existed between change in student self-concept and change in student off-task time.

4. The self-concept variable "social confidence" was a useful predictor of students' achievement in reading and mathematics and their off-task time.

Relationships of Parenting and Aspects of the Home Environment
To Achievement and Self-Concept of Students in Grades 3 to 5

Craig Christopher Olson

Dissertation Abstracts International, in press.
(University Microfilms No. 85-28,442)

This study examined the ability of over 100 qualitative and quantitative home environment variables (HEV's) to contribute to the prediction of reading and mathematics achievement scores and self-concept scores obtained by 198 students from four Wisconsin elementary schools during their third- through fifth-grade years (1979-80, 1980-81, and 1981-82). Matrices of partial-correlation coefficients and variable clusters were examined to identify prominent HEV's. These HEV's were then examined in stepwise multiple regressions with separate sets of achievement, growth, and self-concept scores. Each regression equation also contained a measure of the child's academic aptitude (CAI) as the predominant predictor. Several HEV's provided significant and durable additional predictive capacity to that provided by the aptitude index.

Noteworthy findings include the following:

1. In general, no single HEV or combination of HEV's contributed significantly and consistently to the prediction of any of the seven available indices of self-concept when coincidental associations with the CAI were taken into effect. By the same token, neither did any of the self-concept indices contribute significantly to the prediction of achievement or growth in reading and mathematics.
2. The CAI was an extremely powerful predictor of both achievement and growth in reading and mathematics.
3. An additional variable representing parents' scaled responses to the simple question "how is your child doing in school?" provided significant additional capacity to that provided by the CAI in the prediction of both reading and mathematics achievement.
4. A significant negative association was noted between maternal employment (in hours per day) and boys' achievement in both reading and mathematics.
5. A global index of family socioeconomic status was positively linked with all students' achievement in reading and with boys' growth in both reading and mathematics. The strength of this association appeared to increase as the children matured.

The Great Society Meets a New Federalism: Chapter 2 of the
Education Consolidation and Improvement Act of 1981

Deborah A. Verstegen

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This research examined the distributional and programmatic impact of the Education Consolidation and Improvement Act of 1981, Chapter 2, to determine whether it met the goals for which it was enacted, and whether the Reagan Administration's promises regarding the block grants have been fulfilled.

Data were collected at the federal, state, and local levels using field methodology techniques. A posteriori questions and hypotheses were formulated and tested using regression analysis, T-tests, correlations, or descriptive statistics. The findings included:

1. The reductions in aid accompanying the Education Block Grant began in (FY) 1981. From (FY) 1980 to (FY) 1982, the difference in aid from antecedent programs to the Education Block Grant was -38%. These reductions fell disproportionately on the Mid-Atlantic and Great Lakes areas of the country, and on poor and minority children located mainly in urban schools undergoing desegregation. Six states lost at least half of their antecedent program revenue; the majority lost a quarter of their funding or more. Those states losing the least aid were protected by the sparsity factor in the federal formula.

2. Wisconsin's only large urban area--Milwaukee--accounted for the total loss of aid to the state, although the state distribution formula was designed to favor Milwaukee and the SEA awarded it an additional \$500,000 from discretionary funds. Other LEAs gained an average of \$86 each.

3. The federal appropriation of \$470.4 million resulted in \$3.68 per pupil for one-third of Wisconsin's students; the majority received \$5.68 or less. When targeted by school, Chapter 2 funds fell 7 to 12 times short of the revenue needed to employ one teacher. Although localities were given increased choice in the use of funds under Chapter 2, their options were severely restricted because of the reduced levels of funds available.

This research produced evidence that the promises regarding block grants have not fulfilled, nor have the goals for which Chapter 2 was enacted been met.

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