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ABSTRACT

Student participation was examined in three educational programs and their corresponding environments or settings to determine the relationships between situational and demographic variables and basic skills learning and retention. Subjects were secondary students in four high schools and two career centers in a large midwestern urban center. At the beginning and end of the school year and again after summer recess, students were tested on two subtests of the Comprehensive Tests of Basic Skills (CTBS) and selected items from the National Assessment of Educational Progress (NAEP). In addition, trained observers conducted 360 1-hour observations during the course of the school year. The study methodology examined basic skills achievement as affected by three major sets of independent variables: educational program enrollment, learning environment characteristics, and personal characteristics. Overall, effects were more significant for the school-year learning interval than for the summer retention interval. The factors were not powerful in predicting learning retention. Students in educational programs that explicitly demanded reading and mathematics learning were more successful in acquiring basic skills. Vocational noncooperative students scored lower in mathematics and reading. Vocational students were apparently trading off basic skills achievement for occupational skills development. In the learning interval, independent variables that showed a relationship to basic skills achievement were articulation, task self-initiation, feedback, part-time work, attendance, and gender. In the retention interval, these independent variables showed a relationship: task initiation by others, race, and gender. (YLB)

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FOREWORD

Basic skills deficiencies among youth and even working adults in the United States have been well documented in recent years. The societal and corporate costs of inadequate basic skills preparation are profound. A major problem for educational researchers has been the attempt to characterize the features of learning environments that may promote or retard basic skills acquisition. This report, Basic Skills Retention by Students in Selected Instructional Delivery Systems in an Urban Center, examines student participation in three educational programs and their corresponding environments or settings to determine the relationships between situational and demographic variables and basic skills learning and retention. In doing so, the study builds on and is the final phase of a study of basic skills performance. A previous report discussed basic skills acquisition during the school year (the learning phase of the study), whereas this report focuses on the retention phase (the summer months after the school year).

The intended audience for this report includes vocational researchers, policymakers, and counselors. By employing a variety of testing and interview instruments, as well as a specially adapted observation methodology, this report addresses a question with three components: What sort of student learns and retains which basic skills best in what type of educational setting? Through the participation of a midwestern urban public school system, data were collected for a sample of approximately 400 students during the 1984-85 school year. For this report of retention performance, the 99 students remaining in the study after summer recess comprise the sample. The data measure math and reading performance at three times: pretest, posttest (end of school year), and end of summer recess. Student performance was compared across the four instructional programs of college preparatory, general education, cooperative vocational education, and noncooperative vocational education. The data collection methods used include classroom and work site observations, student testing, and interviews.

Many people have spent considerable time and energy on this study. Although the students, teachers, school administrators, employers, and school system that participated in this study must remain anonymous, we sincerely thank them for allowing the observers the freedom to collect the necessary data. Special appreciation is extended to James A. Dunn, Director of Cornell Institute for Occupational Education, Cornell University, and Thomas R. Owens, Director of Education and Work Division, Northwest Regional Educational Laboratory, for their thoughtful review of this report. The National Center wishes to acknowledge the leadership provided to this effort by Dr. Robert E. Taylor, recently retired Executive Director.

This project was conducted in the Applied Research and Development Division of the National Center for Research in Vocational Education under the direction of Richard J. Miguel, Associate Director, and Michael Crowe, Project Director. Appreciation is extended to June Veach, Graduate Research Associate, for her effort in compiling the final report. We are indebted to James Weber, Senior Research Specialist, and Larry Hettinger, Graduate Research Associate, who helped with the statistical analysis and early parts of the project. We thank Robert Foulk, statistical consultant, for his services in conducting the statistical analysis for the project. We are grateful to staff of the National Center who provided insights during the study's development. Paul Campbell, Senior Research Specialist, conducted an internal review of the report. Special thanks go to Deborah Black who provided expert secretarial and work processing support and Judy Balogh who provided editorial services.

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Chester K. Hansen
Acting Executive Director
National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

Deficiencies in the use of basic skills (e.g., reading comprehension and mathematical computation) are the primary factors limiting the career development of employees who are high school graduates according to more than 65 percent of companies responding to a survey by the Center for Public Resources (Henry and Raymond 1983). The report, A Nation at Risk: The Imperative for Educational Reform (National Commission on Excellence in Education 1983) states that approximately 23 million American adults are considered functionally illiterate. The illiteracy problem is greatest among minorities; illiteracy and the lack of other basic skills, including oral communication and mathematical computation, have been recognized as a serious barrier to low-income and minority youths' successful entry into the labor market (Corman 1980). It is imperative that efforts be made to understand better the factors related to the development of basic skills proficiency at the secondary level.

The Goal and Objectives

The researchers were interested in conducting a field-based study of the relationship between the learner, basic skills, and environmental characteristics. This is an exploratory, heuristic study and no causality is implied. The study must be interpreted in light of restrictions imposed by school districts and organizations. Such restrictions are typical of field-based studies.

This study addresses a fundamental question: What type of student learns and retains which basic skills best in which setting? Although a question of such complexity and scope rarely yields to simple answers, any partial answers represent contributions on which to build. The information gleaned from this study is offered with this understanding.

The study approaches the fundamental question through examination of the following factors:

- Who--Students at the secondary level are identified by gender and race.
- What basic skills--Reading and mathematics achievement were chosen as the salient indicators of basic skills proficiency.
- Which setting--Four different educational curricular programs are examined: college preparatory, general education, vocational noncooperative, and vocational cooperative. The vocational noncooperative program lets students earn credit through the application of academic principles in an in-school, occupational laboratory

setting. The vocational cooperative program allows students to earn credit for on-the-job training and receive classroom instruction to prepare for full-time employment. Characteristics of these learning environments that are amenable to change were used as independent variables.

The preceding framework yielded three specific research objectives:

- to investigate the relationship between participation in a vocational education program and basic skills proficiency
- to examine the relationship of learning environment characteristics to basic skills proficiency
- to identify the students for whom specific changes in the learning environment may promote basic skills achievement

The Methodology

The students who were subjects for this study attend secondary school in a large urban midwestern center. They are enrolled in four different high schools and two career centers.

Basic skills achievement of these students is examined over the learning interval of a school year and for the retention interval of the summer recess. This study builds on and is the final phase of a study of basic skills performance. A previous report discussed basic skills learning during the school year while this report focuses on the retention phase. However, because seniors were not available for testing at the end of the summer, the retention interval of the study was constrained by a smaller sample size and thus fewer variables. Therefore, the researchers decided to examine the learning interval again, using the variables included in the retention study.

The analysis includes 331 students who were pretested at the beginning and posttested at the end of the school year and 99 students who were retested after the summer recess. The students were tested on two subtests of the Comprehensive Tests of Basic Skills (CTBS) and selected items from the National Assessment of Educational Progress (NAEP) at the three testing times.

The CTBS was used because it is a typical measure of basic skills for academic students. Because of time limitations in the participating schools, the reading comprehension and math concepts and applications subtests were selected to measure students' reading and math skills.

The NAEP, which is classified as an application assessment, was used to measure application-type learning. The study included vocational students, who are involved in this type learning. Items were selected from the NAEP to complement the CTBS subtests. Besides being application items, the NAEP items were different in two other respects. First, each item was designed to take two steps to solve the problem. Second, each item was open-ended so that students were required to generate answers rather than select multiple-choice items as in the CTBS.

To achieve the first project objective, the investigation of the effects on basic skills proficiency of a student's being enrolled in a vocational education program, definitions of curricular programs were drawn from program descriptions provided in school district categories. For the school-year learning interval, the number of students participating in each program was: vocational noncooperative, 91; vocational cooperative, 116; general education, 50; and college preparatory, 74. For the summer retention interval of the study, the sample was composed of 36 vocational noncooperative, 26 general education and 37 college preparatory students.

To contribute to the second objective, the examination of the influence of learning environment characteristics on basic skills proficiency, an observational method was employed that focused on identifying classroom and workplace behaviors and activities of students that reflect the following five learning environment characteristics:

- Initiator--who initiated an activity--student, supervisor/teacher, coworker/student, or customer/client
- Feedback--whether the student received direct and clear information about performance effectiveness
- Articulation--whether other students/workers were relying on the student to complete a task before beginning their own
- Mathematics skills usage--the involvement of the student in mathematical problems and operations, ranging from copying numbers to performing higher order mathematical procedures
- Language skills usage--the involvement of the student in reading, writing, or speaking, ranging from reading or repeating simple phrases to reading or composing complex sentences.

Trained observers conducted 360 one-hour observations during the course of the school year. They observed the learning activity involvement of individual students and their interaction with the learning environment. Observers' notes were divided into task "episodes" (Moore 1981), which are defined as segments of

time in which the observed individual's attention remains focused on the completion of a particular task. Behaviors and activities within each task episode were then coded using the definitions of the observational variables and a coding strategy similar to that devised by Halasz and Behm (1983).

In order to speak to the third objective, the identification of the students for whom specific changes in the learning environment may promote basic skills achievement, data were obtained during the spring (O_2 observation) about a number of personal characteristics from school records, teacher ratings, and student interviews. Basic demographic data were obtained from school records, namely gender, race, socio-economic status, and grade level. Grade point average was also taken from the records. Teachers rated students on three work-related characteristics, as follows:

- Attendance--a student's reliability in coming to class or work daily and conforming to scheduled hours
- Dependability--the extent to which the student can be relied upon to perform work properly or on time
- Quality of work--the general quality of a student's work, including accuracy and freedom from error

Students reported the remaining personal characteristics in an interview conducted with a questionnaire in a structured setting. The characteristics reported were as follows:

- Number of academic courses taken
- Number of vocational courses taken
- Educational aspiration--the grade level the student expects to reach
- Part-time job--whether the student is employed out of school
- Television viewing--hours spent watching television out of school

In summary, the study methodology, although limited by the design factors, was to examine secondary students' basic skills achievement as affected by three major sets of independent variables: educational program enrollment, learning environment characteristics, and personal characteristics. The data were analyzed by regression techniques. The findings contribute to a line of inquiry and, in addition to suggesting answers to specific research questions, provide a cornerstone for further research.

The Findings

The research findings are reported by the time period in the study and by the objective that they serve. These findings may be of interest to vocational researchers, policymakers, and counselors, as well as vocational planners, curriculum designers and evaluators concerned with secondary education.

For the Learning Interval

With regard to relationships between basic skill learning and educational program, vocational education students had lower math and reading achievement when compared to general education students. This finding was particularly evident for minorities and females. Similar findings were obtained for vocational co-op students, except that they did not have lower reading scores in comparison with general education students.

With regard to learning environment characteristics, the following relationships were found:

- Higher articulation (cooperative learning efforts) was associated with higher math scores.
- Higher task self-initiation was associated with higher math scores.
- Higher feedback was associated with higher reading and math scores.
- Especially for minority and female students, higher articulation, task self-initiation, and feedback were related to higher reading and math scores and higher required language usage was related to higher reading scores.

With regard to personal characteristics, the relationships found are as follows:

- Reading achievement was lower for males than for females.
- Working part-time was associated with lower reading scores, especially for minority students.
- Better attendance was associated with higher math scores, especially for males. Better attendance was associated with higher reading scores, but only for males.
- The higher the quality of work rating, the higher the math scores, but only for minority and female students.

- Being a senior was associated with lower math scores especially for females and lower reading scores only for minorities and females

Independent variables that showed little or no relationship to basic skills achievement in this learning cycle include math skills usage, socio-economic status, grade point average, dependability, number of academic and vocational courses taken, education aspiration, and television viewing.

For the Retention Interval

With regard to the relationships between basic skill learning and educational program, it was noted that vocational nonco-op students did not retain significantly more or less math than general education students did. College preparatory students especially whites and males, retained more math than general education students did. White college preparatory students retained more reading skill than general education students did.

With regard to learning environment characteristics, the major finding is that the initiation of a task by someone other than the student, such as the teacher, is negatively associated with math retention scores, especially for males.

With regard to personal characteristics, the main finding is that for whites and for females, a higher number of vocational courses taken is associated with higher math retention scores.

The other independent variables showed little or no relationship to basic skill achievement in the retention period.

Summary of Findings

Overall, the effects were more significant for the school-year learning interval than for the summer retention interval. The factors studied were, on the whole, not powerful in predicting learning retention. It was clear that if students scored well at the end of the school year, they tended to score well at the beginning of the next year after the retention period.

For the learning interval, the fundamental question can be asked again: Who learns which basic skills best in which setting? A part of the answer suggested by this study is that the students who are in educational programs that explicitly demand reading and mathematics learning are more successful in acquiring basic skills.

Vocational nonco-op students score lower in math and reading. The findings point to the fact that minorities and females are hampered more than others in basic skills achievement just as they are in the labor market. Where conscious intention and concentration is evident, especially through factors such as task self-initiation, interdependence, and feedback, some positive effects can be noted.

Recommendations

Vocational students are apparently trading off basic skills achievement for occupational skills development. The hints from this study are that exposing these students to more reading and math in and of itself will not result in higher basic skills achievement. Instead, educators should use strategies to gain students' attention such as:

- Encourage participation of vocational students in activities directly related to basic skills, such as language skills usage.
- Involve students, particularly minorities and females, in basic skills activities that give them an opportunity to initiate tasks themselves.
- Plan basic skills activities for students that involve a high degree of interdependence and cooperation.
- Ensure that students receive fair, appropriate, and timely feedback on basic skills performance.

In general, the indications are that vocational educators can help increase the basic skill achievement of their students through an approach that enhances the visibility of basic skill demands in the vocational setting and that signals the importance of meeting basic skill demands in the workplace.

CHAPTER 1

INTRODUCTION

Students who expect to be successful in today's world must be well-grounded in the basic skills.*[1] These are needed for occupational competence and employability, the acquisition of further education and upward mobility, as well as for everyday functioning in our society (Weber et al. 1982).

As a necessary component of education, basic skills must be included in each student's program of study. The concerns that arise are: Do all programs prepare students in basic skills education to the same extent? Do all students learn basic skills with equal success?

The results of the research presented in this report address these concerns by asking the question: Which student learns and retains which basic skill best in which program environment? Through use of a variety of methods, the researchers assessed the relationship of the school environment and of individual demographic and behavioral factors to the acquisition and retention of basic skills. This chapter contains a statement of the problem, objectives for the study, background of the study and limitations.

The Problem and the Context

According to the survey Basic Skills in the U.S. Work Force (Henry and Raymond 1983), more than 65 percent of companies responding reported that deficiencies in the use of basic skills (e.g., reading comprehension and mathematical computation) were the primary factors limiting the career development of their employees who were high school graduates. Among the examples of deficiencies reported were instances of clerical workers unable to read at a level required by the job, supervisory-level workers unable to write reports free of mechanical error, and bookkeepers unable to use fractions and decimals in solving math problems.

The U.S. Department of Education estimates that on an annual basis, 2.3 million people are added to the ranks of functionally illiterate adults, defined as those unable to read at a sixth-grade level. Approximately 1 million are teenagers leaving school without functional reading skills, whereas 1.3 million are non-English-speaking immigrants. The recently released report, A

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[1]*The term "basic skills" refers to reading, mathematics, oral communication (listening and speaking) and writing. For the purpose of this study, basic skills refers only to mathematics and reading.

Nation at Risk: The Imperative for Educational Reform (National Commission on Excellence in Education 1983), states that approximately 23 million American adults are considered to be functionally illiterate "by the simplest tests of everyday reading, writing, and comprehension" (p. 8). The illiteracy problem is most pronounced among minorities; 56 percent of Hispanic and 47 percent of black 17-year-olds are rated as functionally illiterate in standard English ("How Business is Joining" 1984, p. 94). Illiteracy and the lack of other basic skills, including oral communication and mathematical computation, have been recognized as one of the most serious barriers preventing low-income and minority youths' successful entry into the labor market (Corman 1980).

The societal and corporate costs of inadequate basic skills preparation are profound. According to U.S. Department of Labor estimates, approximately half of those unemployed nationwide are functionally illiterate. The same proportion holds for the national prison population.

Estimates of corporate productivity losses attributed to lack of education in basic skills run into the hundreds of millions of dollars. One company, a middle-sized manufacturer, estimated losses of $250,000 arising from inferior work directly attributable to inadequate proficiency in basic skills ("How Business is Joining" 1984, p. 94).

The problem of basic skills competency also extends into the military (Sticht 1984). Given the accelerating introduction of complex technology into the armed services, the urgent need to guarantee adequate basic skills competency on the part of military personnel is obvious.

According to Bureau of the Census data, demographic trends indicate a continuous decline in the number of individuals reaching working age in the coming years. Only 3.2 million people will turn 18 in 1992, 40 percent fewer than in the peak year of 1979. At the same time, "occupations requiring little or no basic skills abilities are rapidly disappearing, while newly created occupations require workers to use reading and writing and computation at a fairly high level of skill in the solving of daily problems on the job" (Sticht and Mikulecky 1984, p. 4).

Given the expected future reduction in the number of 18-year-olds and the rapidly accelerating need for improved basic skills proficiency in light of new job requirements, the need for improving basic skills education is obvious. Recent federal legislation, such as the Job Training Partnership Act (P.L. 97-300), title II, part A--Adult and Youth Programs, specifically recommends basic skills and literacy training as essential priorities for undereducated youths and adults. The purpose of P.L. 97-300 stated in section 2 is

> to establish programs to prepare youth and unskilled adults for entry into the labor force and to afford job training to those economically disadvantaged individuals and other individuals facing serious barriers to employment who are in special need of such training to obtain productive employment.

Section 204, under Use of Funds states that

> services which may be made available to youth and adults with funds provided under this title may include, but need not be limited to . . . remedial education and basic skills training.

Given this context of a profound societal need and a clear federal mandate for action, a major problem for educational researchers is, therefore, to characterize the features of learning environments that do or do not promote the development of basic skills proficiency. In other words, the identification of salient variables in learning environments that are related to basic skills acquisition and retention would be of great use to school personnel concerned with improving the proficiency of their graduates.

Dunkin and Biddle (1974) indicate four major categories of variables involved in research that studies the effects of classroom variables on learning: (1) "presage" variables, such as student and teacher background characteristics, attitudes, beliefs, expectations, and abilities considered to be acquired prior to the learning situation; (2) "context" variables, such as grade level, subject matter, and various social-environmental characteristics of the learning situations; (3) "process" variables, such as overt student and teacher behaviors relevant to the learning situation; and (4) "product" variables, such as the outcomes or results of the learning situation (e.g., standardized test scores, average yearly salary). Their opinion, and that of other researchers in this area (e.g., Brophy 1979; Marshall and Weinstein 1984), is that the least studied of these classes of variables is the "context" variety. As Goodlad (1979) stated,

> Too many researchers are preoccupied with research on single instructional variables that rarely account for more than 5 percent of the variance in student outcomes. Too few study the complex phenomena of schooling in their natural environment, developing the needed new methodologies instead of seeking to adapt the old. (p. 347)

One of the purposes of this report is to identify variables characterizing various types of educational environments that appear to facilitate or repress basic skills retention. The study describes variables in the social-environmental context of the learning situation and their relationship to the acquisition and retention of basic skills competency. By employing a variety of

testing and interview instruments, as well as a specially adapted observation methodology, this report addresses a question with three components: Who learns and retains which basic skill best in which type of educational setting?

Background of the Study

This report is the second and final report for this relational study. The original research effort was designed to examine student participation in four educational programs and their corresponding environments or settings to determine which situational and demographic variables are related to basic skills acquisition. For the previous report the researchers performed a descriptive analysis of the data and conducted a regression analysis of scores from the learning cycle of the project. An overview of the procedures and a summary of the findings from this report (Crowe et al. 1986) is found in appendix A.

Objectives

This heuristic study addresses a fundamental question: Who learns and retains basic skills best in which setting? Although a question of such complexity and scope rarely yields to simple answers, any partial answers represent contributions on which to build. The information gleaned from this study is offered with this understanding.

The study approaches the fundamental question through examination of the following factors:

- Who--Students at the secondary level are identified by sex, and race.
- What basic skills--Reading and mathematics achievement were chosen as the salient indicators of basic skills proficiency.
- Which setting--Four different educational curricular programs are examined: college preparatory, general education, vocational noncooperative, and vocational cooperative. In the vocational noncooperative program, students earn credit by applying academic principles in an in-school, occupational laboratory setting. In the vocational cooperative program, students earn credit for on-the-job training and receive classroom instruction to prepare for full-time employment. Characteristics of these learning environments that are amenable to change were used as independent variables.

The preceding framework yielded three specific research objectives:

- To investigate the relationship of participation in a vocational education program to basic skills proficiency
- To examine the relationship of learning environment characteristics to basic skills proficiency
- To identify the students for whom specific changes in the learning environment may promote basic skills achievement

For the first objective, the investigation of the effects on basic skills proficiency of a student's enrollment in a vocational education program, definitions of curricular programs were drawn from program descriptions provided in school district categories. Basic skills achievement of these students is examined over the learning interval of a school year and for the retention interval of the summer recess. The students were tested on selected items from the Comprehensive Tests of Basic Skills (CTBS) and the National Assessment of Educational Progress (NAEP) at the three testing times.

To contribute to the second objective, the examination of the influence of learning environment characteristics on basic skills proficiency, an observational method was employed that focused on identifying classroom and workplace behaviors and activities that reflect the following five learning environment characteristics:

- Initiator--who initiated an activity--student, supervisor/teacher, coworker/student, or customer/client
- Feedback--whether the student received direct and clear information about performance effectiveness
- Articulation--whether other students/workers were relying on the student to complete a task before beginning their own
- Mathematics skills usage--the involvement of the student in mathematical problems and operations, ranging from copying numbers to performing higher order mathematical procedures
- Language skills usage--the involvement of the student in reading, writing, or speaking, ranging from reading or repeating simple phrases to reading or composing complex sentences.

In order to speak to the third objective, the identification of the students for whom specific changes in the learning environment may promote basic skills achievement, basic demographic data were obtained from school records, namely gender,

race, socio-economic status, grade level, and grade point average. Of the following personal characteristics, teachers rated students on the first three, and students reported on the remaining characteristics:

- Attendance--a student's reliability in coming to class or work daily and conforming to scheduled hours
- Dependability--the extent to which the student can be relied upon to perform work properly or on time
- Quality of work--the general quality of a student's work, including accuracy and freedom from error
- Number of academic courses taken
- Number of vocational courses taken
- Educational aspiration--the grade level the student expects to reach
- Part-time job--whether the student is employed out of school
- Television viewing--hours spent watching television out of school

Limitations

Conclusions and recommendations from this study should be evaluated in light of various constraints that were imposed on the conduct of the research. First of all, the sample of students was drawn from a single, urban, midwestern school district. For this reason the results could be overly specific to the particular school district sampled.

Second, constraints were imposed on the design of the study as a result of the contractual agreement with the school district under study and also because of the structure of this district's curriculum. School officials required that intact classrooms be sampled, rather than individual students, using course descriptions to determine if the class represented college preparatory, general education, vocational nonco-op, or vocational co-op subject matter. The structure of the school district was such that vocational nonco-op classes were offered only in career centers that students themselves chose to attend. The comprehensive high schools that were sampled, to which students were assigned by the school district, offered courses in the other three school programs. Thus, an unavoidable problem was created

in the research design between school building, classroom, and school program, since an orthogonal crossing of these variables was not possible. Therefore, conclusions drawn from the findings may also be explained by the specific organization of classes and curriculum of the school district.

The self-selection of students into programs is an important factor to consider when interpreting the results of the study. A common method of addressing the nature of the self-selection factor is to analyze student demographic characteristics to determine if there are consistent student background variables that explain the self-selection. Because the Office of Management and Budget (OMB) placed restrictions on the types of student data that could be collected, the more traditional demographic variables such as parent education and occupation were excluded from the data collection effort. Thus, the study has limited student background information to examine the factors related to student self-selection into educational programs.

Also, a serious problem of selection bias limits the application of these results. The major role of the pretest scores in explaining the posttest scores, and thereby eliminating the influence of the academic curriculum, strongly suggests prior differences in learning skill on the part of the several groups. Thus, it is not possible to know for sure if those in the nonco-op vocational programs would respond positively to the kind of instruction provided in the academic courses. Another limitation may be that the vocational programs included in the study were primarily business and office programs and marketing education programs. The recommendations resulting from the study may not apply as directly to other vocational areas.

Organization

The report is organized into three chapters. Chapter 2 presents a review of the literature that relates the variables investigated in this study to the acquisition and retention of basic skills. Chapter 3 describes the research methodology. Chapter 4 presents the findings and recommendations. Table 1 is presented at the conclusion of this chapter. The table defines the variables used in this study. Appendix A contains a summary of findings from the previous project report (Crowe et al. 1986).

TABLE 1

DEFINITIONS OF VARIABLES USED IN THE STUDY

VARIABLES	DEFINITION
Educational Program	
College preparatory	Provides students with skills and knowledge necessary for college entry and for success in the college-level academic environment.
General education	Aids students in the development of general knowledge. Students in general education usually are not expressly preparing for college entrance or specific jobs.
Vocational noncooperative	Gives students the opportunity to earn credit through the application of vocational principles in an in-school laboratory setting.
Vocational cooperative	Allows students to choose to earn credit for on-the-job training and receive classroom education to prepare for full-time employment.
Learning Environmental Characteristics	
Initiator	Who initiated the task episode: student, supervisor/teacher, coworker/student, or customer/client. Determined by observation by an outside observer, with lower numbers indicating student self-decision and higher numbers referring to initiation of task by others.
Feedback	Extent to which the student receives direct and clear information about the effectiveness of his or her performance. Determined by an outside observer using a 5-point rating scale, where 1 = student received no feedback on performance and 5 = student received an evaluation for each task.

TABLE 1--Continued

Articulation	How a task episode relates to other tasks in the organization. If other students/workers rely on the student to complete a task before commencing their own, it is an articulated task episode. Presence or absence of articulation was determined by an outside observer, where 1 = student's work was not required for others to complete activities and 2 = others depend on student to complete an activity before they can start theirs.
Mathematics skills usage	The level of task episode requirements for the student to deal with mathematical problems and operations, ranging from copying numbers to performing higher order mathematical procedures. Determined by an outside observer using a 5-point rating scale, where 1 = counting and simple addition and 5 = carrying out complicated advanced mathematical procedures.
Language skills usage	The level of task episode requirements for the student to read, write and speak, ranging from reading or repeating simple phrases to reading or composing complex sentences. Determined by an outside observer using a 5-point rating scale, where 1 = reading simple instructions and 5 = reading complex scurces of information.
Personal Characteristics	
Gender	The sex of each student as determined from information received from school records at the beginning of the study.
Race	Ethnic background of each student obtained from school records. Because fewer than 10 of the minority students in the study were of Hispanic or Asian origin, they

TABLE 1--Continued

	were placed along with black students in a category labeled "minority." The second category was "white."
Socioeconomic status	Student's background as determined from school records by qualification for free or reduced price school lunch. Traditional indicators of socioeconomic status such as parents' income and education were not used because of OMB restrictions.
Grade level	Grade level as determined from school records was used in the learning interval of the study to determine junior or senior status of the student. It was also considered in data analysis as a proxy for age.
Grade point average	Student's academic effort or ability as shown by the grade average for all high school courses, determined by school records, where 1 = D and 4 = A, and collected at the O_2 observation time (spring).
Attendance	Student's reliability in coming to class as determined by teacher rating using a 5-point scale, where 1 = often absent without good excuse and 5 = always regular and prompt.
Dependability	Extent to which student can be relied upon to perform work properly and on time, as determined by teacher/ supervisor using a 5-point rating scale, where 1 = gives up readily, requires continuous checking and 5 = always gets job done, requires little checking.
Quality of work	General quality of the student's work, including accuracy and freedom from errors, as determined by teacher or supervisor rating using a 5-point scale, where 1 = makes excessive errors and 5 = highest quality.

TABLE 1--Continued

Academic courses taken	Number of academic courses, such as mathematics, English, science, social studies and foreign languages taken, as reported by student, and collected at the O_2 observation time (spring).
Vocational courses taken	Number of vocational courses, such as business and office courses, sales or marketing, trade and industry, and technical courses, taken by student, as determined by student self-report, and collected at the O_2 observation time (spring).
Educational aspiration	Student's expectations about the grade level he or she expects to reach in school, as reported by student, where 0 = less than high school graduation and 9 = college program Ph.D. or MD, and collected at the O_2 observation time (spring).
Part-time job	Hours spent by students at part-time, out-of-school work, as determined by student self-report, and collected at the O_2 observation time (spring).
Television viewing	Hours spent by students watching television while out of school, as determined by student self-report, and collected at the O_2 observation time (spring).

Basic Skills Achievement

Mathematics achievement	Student's mathematics learning or retention as measured by scores on the mathematics concepts and applications subtest from the Comprehensive Test of Basic Skills, Form 5, Level J (grades 10.6-12.9) and selected items from the National Assessment of Educational Progress, administered to students in the study during the school year and at the end of summer recess.

TABLE--Continued

Reading achievement	Student's reading learning or retention as measured by scores on the reading comprehension subtest from the Comprehensive Test of Basic Skills, Form 5, Level J (grades 10.6-12.9) and selected items from the National Assessment of Educational Progress, administered to students in the study during the school year and at the end of summer recess.

Other

Learning interval	The period of time from September 1984 to June 1985, or the 1984-1985 school year when basic skill learning was expected to occur. The period was bounded by a pretest at the beginning and posttest at the end.
Retention interval	The period of time from June 1985 to September 1985, or the summer recess from school, at the end of which a follow-up test was given students in the study to measure the amount of retention of basic skills information from the learning interval.
Task episode	Segment of time in which the observed student's attention is focused on the completion of a particular task. This is the unit of analysis for the observation data.

CHAPTER 2

REVIEW OF LITERATURE

Research related to factors involved in basic skills acquisition and retention is reviewed in this chapter. The chapter is organized around four major topics. The first section discusses the relationship between students' participation in educational programs and their achievement. The second section is devoted to describing environmental factors in the classroom that affect learning and retention. The first part of the second section describes the rationale for the measurement of the learning variables using an observational approach. The second part describes the research related to the environmental variables examined in this study. The third section summarizes research that describes the relationships between students' personal characteristics and achievement. The chapter concludes with a review of the retention of basic skills.

Educational Programs

The current study includes school curricular programs as a component to determine influence of program on acquisition and retention of basic skills for high school students. Students are generally placed in one of three curricular programs, or tracks: academic, or college preparatory; vocational; and general. While the three-category track variable is related to ability grouping, its conceptual basis is linked to career plans. College-bound students enter the academic track, work-bound students follow the vocational track, and undecided students take the general track (Hotchkiss, 1986). Within the vocational track are: the vocational cooperative model which allows students to earn credit for on-the-job training and receive classroom instruction to prepare for full-time employment, and the vocational noncooperative model, which lets students earn credit through the application of academic principles in an in-school, occupational laboratory setting.

Being placed in a particular curricular program appears to influence achievement. Alexander and McDill (1976) reported that curricular track affects grades (as reported by class rank), math achievement, educational expectation, and characteristics of a student's peers. Later work by Alexander, Cook and McDill (1978) supported these findings. Weber et al. (1982) found, in a comparison of secondary vocational education, general education, and college preparatory students, that the levels of attainment in reading and math were typically significantly lower for vocational education students than for college preparatory students and were comparable to those of general students.

On standardized basic skills tests, vocational students performed between the 35th and 40th percentiles, or slightly more than one-half of a deviation unit below the average of all secondary students. The difference in average performance is considered statistically and educationally significant (Weber et al. 1982). One would expect this relationship to remain stable. What is not known and what researchers want to learn is the rate of growth in basic skills attainment during the school year, as well as the capacity of certain programs to encourage students' retention of information over the summer following the school year.

Learning Environments

Measurement of Learning Variables

A large portion of the current research effort revolves around an attempt to characterize the environments in which learning occurs by means of an observation methodology more thoroughly described in the previous report (Crowe et al. 1986). Earlier efforts in this direction have been made and are described below.

Chavez (1984) reviewed a number of "low-inference" and "high-inference" observation techniques designed to measure classroom social climates. Rosenshine and Furst (1971) defined a high-inference measure as a rating system that requires an observer to make an inference from a series of classroom events using specific constructs such as satisfaction, cohesiveness, and so forth. They defined a low-inference measure as a rating system that classifies specific, denotable, relatively objective classroom behavior and that uses frequency counts by an observer to record instances of such behavior.

Chavez (1984) noted that most early researchers of classroom behavior were social psychologists. Most of their research, carried out in the early part of the 20th century, was focused on the nature of interactions among students and between students and teachers.

The work of Thomas (1929) was particularly influential in this area. Thomas used "descriptive" (high-inference) accounts of classroom interactions, although she was evidently aware of the problems of subjective bias inherent in this method.

> At their worst, these records are such an inter-mixture of fact and interpretation as to be utterly worthless from the scientific point of view. Even at their objective best, the selection and emphasis are more or less dependent on the recorder. (p. 3)

Early research in a similar vein, employing observational methodologies, was conducted by Lewin, Lippit, and White (1939) and by Lippit (1940) on the nature of social interactions within and between groups of students. At a later date, Anderson and Brewer (1945, 1946) began developing observational methodologies in an attempt to describe the effect of teachers' classroom behavior on students' behavior and the effect of students' classroom behaviors on each other. These methodologies, however, retained the same problem of potential contamination by subjective bias on the part of the observer.

Chavez (1984) noted that as the 1950s approached, classroom research became more empirically rigorous (low-inference).

> Hypotheses were derived from analysis of time lapse pictures, recordings . . . and observations in the classroom by sensitive and trained educators using newly developed measures, which were often compared with the results of standardized tests (cf. Medley and Mitzel 1963; Withall and Lewis 1963). (Chavez 1984, p. 240)

Amidon and Hough (1967) have discussed another highly influential observational system developed during the 1960s called the Flanders Interaction Analysis System (FIAS). This system was regarded as innovative at the time because of its capability of preserving a large amount of information specific to the sequence of behaviors being observed. The FIAS tended to focus on teacher influences in the classroom, and rated 10 factors on their direct and nondirect influence. This system was used extensively throughout the 1960s and 1970s. Although less inferential in nature, the emphasis on teacher characteristics tended to detract from the importance of the student's relation to the learning environment.

Nevertheless, a great deal of research has been concerned with the effect of various teacher characteristics on the acquisition of basic skills. Anderson (1982), for instance, discussed the acquisition of basic skills as a function of teachers' "classroom management" skills. As conceived by Anderson, classroom management involves such teacher responsibilities as

> organizing the physical environment and student movement through the room, scheduling and pacing various activities, organizing instructional supplies and materials and arranging for their use in ways that facilitate learning, keeping up with student programs for the purpose of guiding instruction, monitoring students' attention and behavior to ensure that they benefit from instructional activities, and attending to the many routine details of school life. (p. 33)

Brophy and Putnam (1979) found that teacher classroom management skills were a major predictor of student achievement in the basic skills of reading, mathematics, and language. The strong positive effect of classroom management may result from the increased time in which students are engaged in instruction or learning activities. However, the question of how one can measure a variable such as classroom management in a reliable way is not addressed by Brophy and Putnam. Although teacher behavior in the classroom is undoubtedly important in students' acquisition of basic skills, the model for this study makes the student, rather than the teacher, the unit of analysis.

Brophy (1979) pointed out that many educators and educational researchers are overly concerned with issues of curriculum at the expense of issues of teaching method and, we would argue, at the expense of educational environmental concerns. He stated that "it seems intuitively obvious that educational outcomes will be determined by both what is taught (curriculum) and how it is taught (method) and that both aspects need investigation" (p. 734). Although applied to the early grades by Brophy, his conclusions may also apply to secondary-level learning environments. He concluded that learning gains tended to be most impressive in classrooms in which students engaged in a great deal of interaction with the teacher. Lessons that were briskly paced, but conducted at a difficulty level that allowed consistent success, tended to promote greater learning. Flanders (1970) obtained data that indicated that a good environment for learning is exemplified by extensive teacher elicitation of student ideas, the integration of these ideas into the content of class discussion, and the reinforcement by generous praise for valuable student contributions.

Other areas of research have concentrated less on the teacher as the primary focus of interest and more on the student. A great deal of this research focuses on the student's perception of the school or classroom environment and the effect of that perception on various measures of school performance.

Magnusson (1981a) differentiated between describing the environment "as it is" and the environment "as it is perceived." This distinction is also maintained in the current study, which seeks to characterize the environment as it is by means of "task episode" analysis (Moore 1981).

The usefulness of assessing the perceived nature of the learning environment lies in its value as a predictor of a student's chances of success in the attainment of basic skills proficiency. As Magnusson states,

> Having an understanding of an individual's conceptions of the world and an understanding of his perceptions and interpretation of the specific situation in which he finds himself makes it possible to understand his actual behavior in that situation. (p. 5)

Magnusson (1981b) puts forth two fundamental reasons for making "situations" (i.e., the social-environmental context in which behavior occurs) a subject for observation and analysis: (a) situations are important from a developmental perspective, in that individual perceptions of situations mediate between the actual environment and an individual's developing conceptions and attitudes in relation to it; and (b) behavior does not occur in a social vacuum, but takes place within and is directly influenced by the context of a particular physical-social environment. For these reasons, realistic and functional models of psychological processes (e.g., the acquisition of basic skills proficiency) must attempt to account for the influence of situational factors.

Magnusson stated that events and sequences of events may be the important units of analysis in investigating any person-by-situation interaction. The task episode, the fundamental unit of analysis employed in attempting to assess the physical-social environment as it is in the present study, represents an attempt to capture quantitatively the complexity of situational effects being called for by Magnusson, Goodlad, Brophy, Marshall and Weinstein, and others.

Marshall and Weinstein (1982, 1984) have also been concerned with the development of an observation system that can adequately capture the complexity of the classroom environment. However, they stress the difficulties involved in developing a system that is sufficiently sensitive to subtle, yet potentially meaningful, variations in the classroom environment. Though perhaps easily perceived by students and potentially influential on school performance, these phenomena may be undetected by an insufficiently sensitive observation system. For this reason, it seems essential not only to develop increasingly sensitive observational systems, which is one of the goals of the present research, but also to supplement these systems with other research instruments in order to assess the student's own perception of the environment. Thus, a variety of instruments must be used to arrive at an adequate description of the social-physical nature of the classroom, since no single instrument is likely to be sufficient.

An evaluation of a model of learning that proposes multiple influences, of which the model for this study is an example, must measure many aspects of the learning situation in order to characterize adequately the processes involved. The major criticism of the majority of the aforementioned studies is that their scope of research has been too narrow to capture the complexity of the learning environment.

Environmental Characteristics

Several of Marshall and Weinstein's (1984) concerns in characterizing the nature of the "task structure" within the classroom have parallels with the "task episode analysis" technique used in the present study. Marshall and Weinstein are concerned, for instance, with the following factors: (1) the variety of tasks occurring simultaneously, (2) divergencies in processes and products of the task, (3) differences in the sequence and pace of tasks for different individuals, (4) the level of task difficulty, and (5) the amount of content covered. By "divergence in processes and products," Marshall and Weinstein refer to situations in which the task is such that students can carry it out in highly individualized ways, and in which no particular right answer or set of right answers is necessarily involved. This situation is referred to as "divergent production." As the authors indicate,

> Previous research has overlooked the possibility that where tasks require divergent rather than convergent processes or result in dissimilar products, comparative evaluation between students' work may be more difficult to make. (p. 308)

This process dichotomy may indicate a difficulty in comparing the standardized test performance of college preparatory and vocational education students. The former curriculum may emphasize more divergent types of cognitive strategies whereas the latter may emphasize more convergent strategies.

Initiation. One factor of the learning environment to be examined is the amount of freedom a student has to initiate a task. The teacher usually controls responsibility for learning in the classroom. The extent to which the teacher shares that responsibility with students may affect student achievement. Where teachers emphasize passive/prescriptive learning, students may have little opportunity to initiate tasks. The teacher who shares responsibility for learning with students gives them choices, such as in the sequence of tasks to be completed, the pace of task completion, groups to work with, the creation and direction of learning tasks and the establishment of learning goals (Marshall and Weinstein 1984).

Nearly all theories of learning (cf., Bower and Hilgard 1981) emphasize the importance of variation and experimentation for effective learning and subsequent retention of material. Research by Lezotte et al. (1980), Brookover et al. (1979), and others concludes that the degree to which students are self-reliant or perceive themselves in control of their environment enhances achievement. Weinstein et al. (1982) reports that students perceive that teachers give more choice to high achievers and more direction to low achievers.

An indirect consideration of initiation of tasks as an environmental factor is that teachers who expect more of students may show it by giving them more choice in initiating and completing a task. Studies have shown repeatedly that a positive school learning climate with high expectations for all students is strongly associated with high achievement (Lezotte et al. 1980; Squires et al. 1983; Brookover et al. 1979; Berliner 1984; Marshall and Weinstein 1984; and Ouzts 1986). Students who are self-learners rather than passive learners tend to achieve more when the teacher allows them to make their own decisions and to initiate activities (Schroder et al. 1973; Marshall and Weinstein 1984).

Articulation. An environmental factor related to the task structure is articulation. In the classroom, articulation is defined as the interaction of tasks performed within a task episode. For example, if other students or workers rely on a student to complete a task before commencing their own, it is an articulated task episode. As a component of cooperative learning, articulation falls into the area of group dynamics and cooperation, work on which was spearheaded by Lewin, Lippitt and Deutsch, and by Dewey, who emphasized social aspects of learning and the role of the school in educating students in cooperative democratic living (Slavin 1985). The relationship of cooperation and competition as conditions of the interdependence of individuals was described by Deutsch (1949):

> The crux of the differences between cooperation and competition lies in the nature of the way the goals of the participants in each of the situations are linked. In a cooperative situation the goals are so linked that everybody sinks or swims together, while in the competitive situation if one swims, the other must sink. (p. 129)

Deutsch distinguished between the two conditions on the basis of individual goal relationships. Since then, Slavin (1983) further defined cooperative learning structures by introducing task specialization as another source of interdependence separate from group study. In task specialization, each student has a particular part of the group task to complete; in group study there is no such specific assignment of tasks. Both task and group goals may be ordered along a continuum ranging from zero, where students' tasks are different, through varying degrees of increasing similarity, to identity of work assignments (Pepitone 1985). Articulation can be described as an element of task specialization and thus of cooperative learning.

Johnson and Johnson (1985) reported that cooperative learning experiences promote greater achievement and retention than competitive or individualistic experiences. These results were obtained from 26 studies of nearly all grades including college, a

variety of content areas and periods of time, as well as from a meta-analysis of all studies conducted on social interdependence and achievement. In studies of elementary and secondary students engaged in a variety of math and verbal tasks and a knowledge-retention task, Johnson and Johnson found that cooperation promoted greater achievement than competition and individualistic efforts.

On this basis, vocational programs, with a greater amount of laboratory and work experiences, would be expected to produce more articulation and task specification and therefore greater attainment and retention of basic skills than college preparatory and general education.

Feedback. Weinstein (1976) emphasized the role of feedback as an additional environmental factor in establishing an effective or ineffective classroom environment. For example, when a great deal of positive feedback for less than perfect performance is given, differences in expectations for adequacy of performance may emerge. In general, the criterion used by a particular instructor for positive and negative feedback, in combination with perceived consistency of differential application of positive and negative feedback by the instructor to particular individuals within the class, may greatly affect the perceived environment of the students.

Cognitive psychologists propose teaching cognitive skills by demonstrating, then giving students an opportunity for repeated practice and feedback (Frederiksen 1984). Berliner (1984) advised that appropriate use of feedback--praise for correct work, substantial use of corrective feedback and use of students' ideas to let them know their ideas are valued--all are related positively to achievement. He advised against sarcasm and personal attacks, which have been shown to be negatively related to achievement. Berliner noted that criticism, couched in emotionally neutral terms, has been found to be accepted by students, while Silvernail (1979) concluded that strong disapproval and criticism, as well as elaborate praise, do not promote achievement. Mild criticism, however, is effective, depending on the nature of the learning task. Rosenshine (1986) reported that students learn better with feedback, preferably immediate feedback, and that student errors should be corrected by process feedback, or reteaching.

Personal Characteristics

Several factors must be considered in assessing the effect of student characteristics on student basic skill achievement. Traditional demographic data of race, sex and socioeconomic status should be appraised for their relationship to basic skill acquisition and retention. Factors that can portray student attitudes toward the educational environment include student grades, school attendance, educational aspirations, quality of

work and dependability. In the nonschool environment, one should consider the student's use of time away from school, e.g., the amount of time spent watching television and working at a part-time job.

Demographic Characteristics

Student demographic information should be considered in looking at factors that affect basic skills acquisition and retention. Although the Office of Management and Budget restricted collection of certain types of student data, other student characteristics could be examined. They are gender, race, and socioeconomic status. The latter was measured by participation in a free or reduced-cost lunch program, used as a proxy for socioeconomic status.

Race, socioeconomic status and gender have gained attention over the years as factors affecting educational attainment. Probably the greatest attention has been given to differences of gender and the process of math achievement. Men have traditionally been attributed with achieving higher math scores than women, although the two sexes begin their high school programs with equal math abilities. There appears to be evidence that by age 17, men demonstrate greater ability in spatial visualization related to problem-solving in mathematics, and that the difference may be related to hormonal differences affecting brain organization. These biological differences are not conclusively established, however (Levini and Ornstein 1983).

Some researchers attribute this difference to socialization processes and sex-role stereotyping, while others believe the answer lies in superior male mathematical ability. Ethington and Wolfe (1986), however, reported that the difference may be more complex. They found attitudes toward math were more negatively influenced by verbal abilities for women than for men, and found attitudes to have a more significant influence on achievement among men.

Gender differences in math achievement and retention can be expected to persist. On the other hand, studies of reading achievement at the high school level show less significant gender differences.

Whereas boys have traditionally been thought to be better at math, girls have been given credit for greater reading ability. This has largely come from studies of reading by Gates (1961) and others in the 1960s and 1970s. However, these studies measured reading achievement by vocabulary and short passage comprehension rather than by verbal aptitude, which includes a variety of verbal tasks. Gates's study was criticized for small significance despite large sample size. Earlier and later studies of gender difference at the high school level failed to obtain significant gender differences. A 1980 study of more than 23,000 seniors

nationwide found that gender accounted for less than 1 percent of the variance in reading achievement. On the other hand, a national study of 36,000 17-year-old students found that females performed above males by 2.76 percent. However, for males and females who read daily in their spare time, the performance was almost the same (Hogrebe, Nist, and Newman 1985). Lack of significant gender differences in high school reading achievement would indicate that similar results should appear in the current study.

Race differences also may be associated with achievement differences. Castenell (1983) suggested that race, socioeconomic status and gender have a great influence on specific types of achievement behavior. A national study sponsored by the U.S. Department of Health, Education and Welfare (1976) found gross differences in achievement between 12-17-year-old black and white students, with the average score for white youths higher than that for black youths on both reading and arithmetic achievement tests. White students have also tended to score higher than black students on achievement motivation tests that emphasized traits such as locus of control and delayed gratification. However, Castenell (1983) found in a study of eighth grade students that the traditional, middle-class approach to investigating group differences on achievement motivation may be too narrow for black-white comparisons. Castenell suggested that black students' desire to achieve can be channeled in several directions, such as peers and home, while white students are more likely to demonstrate their desire to achieve through traditional channels, such as school.

Conflicting results have been found in studies of social class differences and achievement. Lower-class subjects in one study were found to lack delayed gratification, which is considered necessary for achievement (Castenell 1983). Castenell reported no difference in social class on an achievement motivation scale that emphasized home and peer as well as school achievement motivation. However, males and upper socioeconomic level students scored higher on a scale emphasizing traditional middle-class concepts of achievement, such as self-esteem, independence, sense of control and individualism. Results of several studies indicated that family background was a major influence on students' achievement; other studies concluded that socioeconomic status could not explain differences between high- and low-achieving schools (Lezotte et al. 1980).

Social class was cited by Pottebaum, Keith, and Ehly (1986) as a factor affecting self-concept and academic achievement. In a national study of the causal relationship between self-concept and achievement among high school students, they reported that their results agreed with those of other researchers in that there may be no causal relationship between the two factors, but that they may be caused by a third variable such as social class and ability.

From the results of existing studies on the effect of gender, race, and socioeconomic status on achievement, one would expect that all three may affect basic skills attainment and retention. In particular, gender may affect math attainment and retention. Race and social class may affect achievement and motivation for achievement.

Student Attitudes

Student attitudes toward learning play a part in effecting student achievement. Brookover et al. (1982) reported that student attitudes differ from school to school and are defined by group norms among students. These norms determine the prevailing standards for emphasis on grades and importance of academic work in their lives. These variations in academic norms, while related to achievement, are also influenced by teacher expectations.

Student self-concept of academic ability is also related to achievement. A student's confidence in ability to succeed in school is related to past experiences in school, as is the student's sense of academic futility (Brookover et al. 1982). If students receive low grades in school, these would be expected to enhance the students' feelings of academic inadequacy and hopelessness and in turn foster further low academic achievement. This attitude would be seen in such indicators as school attendance, dependability, quality of work, and educational aspirations. In this study, these factors are defined as follows: School attendance is defined as a student's reliability in coming to class daily and conforming to scheduled hours. Dependability is the extent to which the student can be relied upon to perform work properly and on time. Quality of work describes the general quality of the student's work, the accuracy and freedom from errors. Educational aspirations indicate the student's expectations about the grade level he or she will reach in school.

Use of Nonschool Time

In the student's nonschool environment, two measures that can relate to basic skills acquisition and retention are amount of time spent at a part-time job and amount of time spent watching television. Both are included in this study.

Student part-time employment. Time spent on part-time work by teenagers while in school has given them many benefits, including developing business knowledge, responsibility, and self-reliance. At the same time it has provided problems for educators and students in increased absenteeism, less time for school activities, decreased enjoyment of school, and decreased academic performance for those who work 15 hours or more a week (Greenberger and Steinberg 1980; Steinberg et al. 1982). Although

more than half the teenage population from 16 to 19 worked in 1981, and about two-thirds of high school seniors are employed at any given time in an academic year, rarely do researchers consider the influence of work on educational achievement. In a national study of male high school students, Finch and Mortimer (1985) suggested that working during the sophomore and junior years of high school may have a negative effect on school achievement. Time spent working in the 10th grade had a significant negative effect on grade point average in the 11th grade, with prior achievement controlled. There were contemporaneous negative effects of work on achievement and achievement on work hours in the 11th grade, controlling for ability. However, no significant relationship was found between work hours and achievement in the 12th grade.

Steinberg et al. (1982) found, however, that not merely working, but working long hours depressed school performance. Further, the number of hours a student could work each week without a drop in GPA was different for 10th and 11th graders. For 10th graders, the drop in GPA occurred at or after 15 hours a week. For 11th graders the drop occurred at or after 20 hours.

On the other hand, Lewis, Gardner, and Seitz (1983) found in a national study of working students that work experience has either no effect or a slightly positive effect on grades. Lewis reported that some of these students tended to report more school problems, such as cutting classes and suspensions, or delinquent behavior such as shoplifting or using marijuana. Lewis did report, however, that where students had school supervision of work experience, some equity objectives appeared to be achieved. More minority and socioeconomically disadvantaged students participated and males and females received equal pay.

Although the Finch and Mortimer study was restricted to men, Greenberger (1983) and her associates reported on employment for females. They found that employment may have more positive consequences for adolescent females and their adult attainment than males by increasing female self-reliance and reducing excessive dependence on parents.

Findings of a national study by Steinberg et al. (1982) were that although part-time employment leads to lower school involvement and poorer school performance, it appears to facilitate the acquisition of practical knowledge about the business world, money, and consumer transactions. In addition, the positive effects of working on practical knowledge are most pronounced for students who show poor academic performance.

In regard to program, Crowe et al. (1986) reported that vocational students are more likely to work at a part-time job during the year and to work for longer hours. This may offset benefits realized from working by decreasing academic performance.

Television watching. The use of students' out-of-school time and its relevance to academic achievement has been a concern of educators. In a national study of the effect on achievement of television watching and homework, Ward, Mead, and Searls (1983) found, in general, that television and homework may compete for some students' time and thus affect achievement.

The study of 9, 13 and 17-year-old students indicated that they watched progressively less television as they grew older. Among 17-year-olds, the age group most closely associated with the current study, television viewing dropped sharply compared to that of 13-year-olds; 38 percent watched less than one hour a day while 8 percent watched more than four hours. Students at each age who watched television for more than four hours daily had the poorest reading skills. For younger children, reading performance improved as television viewing increased, up to a point, after which reading performance declined. Only for 17-year-olds was there a direct negative association between the two. Those who watched the least television were the best readers, with performance dropping steadily as television watching increased. At all ages males watched more television than females (Ward et al. 1983). These results would indicate that students who watch less television should show greater achievement on basic skills learning and retention.

Retention of Basic Skills

The focus of this final phase of the study is retention of basic skills information three months after the end of the school term. How is retention of information accomplished? Recent studies indicate that memory retention now is believed to be influenced by how much information is processed when it is perceived, rather than on capacity or forgetting characteristics of short-term memory or type of information code (e.g., acoustical, semantic or visual) (Laster 1985).

Memory is basic to theories of information-processing. Cognitive psychologists recognize three kinds of memory: a sensory buffer, long-term memory and short-term memory (Frederiksen 1984). A sensory buffer registers a stimulus event and either stores it in long-term memory or ignores it. Long-term memory contains permanent knowledge and skills. Information is stored in a cluster, or chunk, of related items, or nodes (Frederiksen 1984). Short-term, or working, memory contains information actively being used. Information flows into and out of working memory from long-term memory and the sensory buffer. While short term memory has a limited capacity, chunking--allowing a single symbol or concept to represent a collection of related items of information--can greatly increase capacity (Frederiksen 1984).

Schneider and Shiffrin (1977; Shiffrin and Schneider 1977) reported that information processing falls into two categories: controlled and automatic. With controlled processing, a sequence of nodes (items) is activated under the person's control. Since it requires attention, only one sequence can operate at a time. With automatic processing, a set of nodes is activated, but is under the control of a particular input to working memory rather than under the control of the person. Thus, the processing is automatic and does not require the person's attention.

Two visual-search tasks can be carried out simultaneously if one is performed automatically and if symbols used are consistent (Schneider and Fisk 1982). Therefore, it is possible to increase problem-solving ability by using automatic processing of information for routine parts of an activity, such as reading, leaving to controlled processing the less routine aspects of problem-solving (Frederiksen 1984).

Another concept, the idea that learners determine what they learn, has implication for basic skills retention. In locus of control research, de Charms (1972, 1976) reported that students could increase achievement if they believed they could influence their performance by their efforts. After training, students had significantly reversed the expected trend and remained at a significant 6-month advantage in grade placement a year later.

Craik and Lockhart (1972) note that memory seems not to be improved by rehearsing or repeating. However, retention increases when depth of processing information moves from shallow processing, where the person analyzes physical or sensory features of information, to deep processing where the person is concerned with semantic analysis (e.g., recognizing patterns and meanings) and elaborative processing using higher-level cognitive skills. Laster (1985) concluded that meanings and deeper levels of processing are important in retaining information in long-term memory.

It appears that mathematics and reading retention can be enhanced where information processing involves automatic as well as controlled elements in learning tasks and where processing involves higher-level cognitive skills. In addition, where students perceive themselves as controllers of their performance, retention is enhanced.

Summary

This review of literature has focused on factors in the classroom setting as well as student and academic program characteristics that may affect basic skills learning and retention. Classroom factors that have been found to have an impact on academic achievement and retention are student initiation of tasks, articulation, and feedback. In addition, student attitudes toward learning may be manifested in grade point

average, school attendance, dependability, quality of work, and educational aspirations. Thus, these factors can be predictors of basic skills learning and retention. In the student's nonschool environment, hours spent watching television and working at a part-time job can influence academic achievement. Demographic characteristics, such as the student's gender, race, and socioeconomic status, are predictors of student achievement. Finally, the program in which students are placed has been shown to affect their basic skills acquisition and retention. Understanding the student's cognitive processing abilities and using methods to increase long-term information processing can be expected to enhance mathematics and reading retention. When included in a study of basic skills retention, classroom environment factors and student characteristics variables can help answer the question, "Who learns basic skills best in which program?"

CHAPTER 3

METHODOLOGY

This chapter describes the design of the research and the instruments that were used to observe students' behavior, to describe learning environments, and to measure basic skills achievement. A description of the sample of students, their school programs, the data collection procedures, and a statistical analysis will also be provided.

Research Design

This research was conducted with the assumption that the acquisition of basic skills proficiency is a function of at least three groups of factors: school program factors (e.g., student enrollment in a college preparatory, general education, or vocational education program); learning environmental factors (e.g., feedback, student initiation of tasks); and personal factors (e.g., demographic characteristics, nonschool time use). The authors hypothesized these factors are all relating to the acquisition and retention of basic skills for high school students. To determine students' basic skills proficiency at different stages of the school year, a repeated measures design was used. This design is depicted in figure 1.

Data were collected during the course of the 1984-85 school year. In January 1986, a report was prepared that described the basic skill achievement during the learning interval (Crowe et al. 1986). For the current phase of the study, the aim is to describe the retention of basic skills of students who participated in school programs. Because the co-op students were seniors and were not available for retention testing, the retention analysis was completed for college preparatory, general education and vocational nonco-op students.

For the retention analysis, the researchers have selected independent variables based on the literature reviewed in chapter 2. (See table 1, chapter 1 for a description of the variables.) The same variables will be described for the learning interval as well. The variables can be grouped into the following categories:

- Program participation

  - College preparation
  - General education
  - Vocational, nonco-op
  - Vocational, co-op (used in learning only)

- Learning environment variables

  - Feedback
  - Student initiation of task
  - Articulation
  - Mathematics skill usage
  - Language skill usage

  The last two are included in order to examine the patterns of exposure to basic skills related to school programs. While teaching basic skills is the primary function of the classroom environment, the application of basic skills to real-world tasks generally takes place in work settings. However, the potential for basic skills acquisition in the work setting should not be overlooked. The level of exposure to basic skills can be considered for this study as an indicator of the demand for basic skills acquisition or application in different settings. If school programs vary in their demand for a skill, one would expect that students will vary in achievement rates for that skill, depending on the environment.

- Personal characteristic variables

  - Gender
  - Race
  - Socioeconomic status
  - Grade level
  - Grade point average
  - Attendance
  - Dependability
  - Quality of work
  - Academic courses taken
  - Vocational courses taken

  Students were asked to indicate the grade levels in which they had taken academic and vocational courses. This was done to determine the background or extent to which students were being exposed to academic and vocational courses.

- Educational aspirations
- Part-time job
- Television viewing time

As indicated in figure 1, the assessment of the students' mathematics and reading achievement (dependent variables) was undertaken during the school year and at the end of the summer. For purposes of the report, the decision was made to compute a total mathematics score and a total reading score (per test administration) based upon the combined sets of mathematics and reading items from the Comprehensive Tests of Basic Skills and selected items from National Assessment of Educational Progress.

Instruments and Data Collection

To achieve the project objectives for the learning and retention intervals, a variety of research instruments and processes was employed. The relationships (shown by an X) between the specific instruments and the research variables are illustrated in figure 2. A brief description of each instrument follows.

Observation--Task Episode Analysis

A large part of the effort that went into this research centered around the development of an observational method that would allow description of learning environments in terms of an array of variables (see table 1, chapter 1), each of which would be quantifiable at least at the ordinal level of measurement. The study's partial focus on environmental characteristics affecting basic skills acquisition required that students be observed and their behavior be described as it occurred in actual learning environments. These environments were expected to answer partially the question: In what setting do students learn basic skills best? To capture information from these settings, it became necessary to use a naturalistic observation technique to collect environmental information and to develop a heuristic framework for describing the phenomena observed.

Moore (1981) introduced the method of "task episode analysis" in the context of anthropological research; his general technique was used as the model for the observation methodology used in the current study. This method of observation focuses on the processes by which students encounter and accomplish tasks, the general features of the environment, and their impact on learning. According to this method, the unit of analysis is the "task episode," defined as a segment of time in which an individual's attention remains focused on the completion of a particular task. The task episode is event dependent rather than time dependent. It may consist, for example, of a series of events in which a student encounters a problem, works on it, and receives

Educational/ Curricular Programs*	COLLEGE PREPARATORY	GENERAL EDUCATION	VOCATIONAL NONCO-OP	VOCATIONAL CO-OP	
	X_1	X_2	X_3	X_4	
Environments/ Settings	Classroom	Classroom	Classroom Laboratory	Class/ Lab	Work Site

Repeated Measures Design

O_1 X_1 O_2 O_3

O_1 X_2 O_2 O_3

O_1 X_3 O_2 O_3

O_1 X_4 O_2

Observations	Time	Measures
O_1 (preprogram)	9/84	o CTBS; Math, Reading o NAEP; Math, Reading
O_2 (postprogram)	6/85	o Same as O_1 measures plus o Student, faculty/supervisor interviews
O_3 (follow-up program)	9/85	o Same as O_1 measures
O_1 to O_3 (program environment)	10/84-11/84 and 2/85-3/85	o Observations of selected students in program settings

*Curricular programs can be generally defined as follows: college preparatory--those preparing students for college; vocational--those preparing students for employment immediately following high school graduation; general--those with students considering themselves to be in neither academic nor vocational programs (U.S. Department of Education, National Center for Education Statistics 1983, p. 36).

NOTE: The time from O_1 to O_2 comprises the learning interval while the time from O_2 to O_3 comprises the retention interval of the project.

Figure 1. Research design

Research Instrumentation	RESEARCH VARIABLES		
	Basic Skill Attainment	Program Environment Characteristics and Factors	Student Pers Characterist
Observations		X	
Comprehensive Tests of Basic Skills and Selected Items from National Assessment of Educational Progress o mathematics o reading	X		
Teacher Interviews			X
Student Interviews			X
School Records			X

Figure 2. Relationship between research instrumentation and research variables

information about the quality of performance. The length of the task episode is a function of the type of activity being performed; it is not, therefore, dependent on any arbitrary unit of time.

Using Moore's framework as a starting point, project staff developed an observation protocol for identifying and describing the mathematics and reading skills demands and environmental factors in the four program settings. Observations of student behaviors were conducted in the form of comprehensive field notes, easing the observer's burden of having to record and classify events simultaneously. Observers were instructed to review their notes following each observation period in order to add more specific information where it was needed. At this point, the observer divided the field notes into task episodes by identifying intervals during the observation period in which a student's attention was directed toward the completion of a particular task. Since observations were conducted in the classroom and in the student's part-time co-op workplace, typical task episodes included taking a test, working on a math exercise, reading a short story, bagging a customer's groceries, or preparing a food order in a restaurant. Behaviors and activities within each task episode were then coded using the definitions of the observational variables and a coding strategy modeled after that devised by Halasz and Behm (1983). The format of the coding form was modified to incorporate both the idea of task episode analysis as well as the specific behaviors related to environments and basic skills performance.

Observers for the current study received extensive training and practice in coding videotaped classroom and work place situations followed by group instruction and discussion on procedures for recording and classifying the events in an observational period. Emphasis was placed on establishing a consistent criterion for identifying individual task episodes and on maintaining consistent scoring for observed levels of the observational variables.

The reliability of the observations was assessed in two ways. First, during observer training, the trainees took field notes and coded them according to a previously set criterion, so that their coding forms matched the exemplary forms. Second, during the actual on-site observation period, one of the researchers in the study went out with each observer to take field notes and code them independently of the observer. The criterion used for reliability between raters was a 95 percent match between coding values on the coding form. This criterion was achieved in all cases. A total of 360 one hour observations was obtained for the study.

Basic Skill Tests

The dependent variables, mathematics and reading performance, were measured by two tests--The Comprehensive Tests of Basic Skills (CTBS) and selected items from the National Assessment of Educational Programs (NAEP).

CTBS. The CTBS, Form V, Level J (grades 10.6-12.9) was used as one means of assessing basic skills achievement and retention. A series of norm-referenced achievement tests, the CTBS was used because it is a typical measure of basic skills for academic students. Because of time limitations in the participating schools, the reading comprehension and math concepts and applications subtests were selected to measure students' reading and math skills.

Forty-five items composed the CTBS reading tests. The vocabulary items measure categorization, same-meaning words, words in context, multimeaning words, and word affixes. Reading comprehension items measure skills in understanding sentence meaning, passage details, character analysis, main ideas, generalizations, written forms, and author techniques.

Forty-five items composed the CTBS math test. Mathematics computation items measure the operations of addition, subtraction, multiplication, and division. Applications of mathematical concepts and conventions are measured in such content areas as numeration, number sentences, number theory, problem solving, measurement, and geometry.

NAEP. Selected mathematical and reading items from the NAEP test were administered in conjunction with the CTBS as a converging measure of basic skills achievement at the three test intervals. The staff obtained the necessary instructional scripts from NAEP personnel and produced an audiotape for test administration according to NAEP specifications.

The 24 NAEP math items used were classified as involving the application of routine problem-solving strategies. These items had national norms in the lower 50th percentile so that students would have an opportunity to show improvement with time. Students were required to generate an answer rather than select a multiple-choice response as in the CTBS. The NAEP items were chosen to complement the CTBS math items. Three reading passages with a total of 15 test items, classified as expository/evaluative and using a multiple-choice format, were selected to supplement the CTBS reading test.

Data collection procedures. Data collection was carried out during the 1984-85 school year. During the first month of school, both the CTBS and NAEP tests were administered to obtain a baseline measure of basic skills proficiency at the beginning of the school year. During the last month of the school year,

students took the CTBS and NAEP tests again. This round of testing was carried out in order to compare students' basic skills proficiency at this stage of the school year with that of the beginning of the year. Finally, in September 1985, the CTBS and NAEP tests were administered to students to measure retention of basic skills information following the summer months.

Teacher Interview Form

The staff also developed an interview form to elicit information from teachers about student performance in the classroom. These ratings were analyzed to isolate student work or classroom characteristics that could relate to basic skills achievement. The form was pilot tested with nine teachers and supervisors and submitted to OMB for approval. The interview form included questions about student's attendance, dependability, and quality of work. These interviews were completed during spring 1985.

Student Interview Form

The staff developed an interview form in order to obtain information from students that could be used in conjunction with the achievement test data to isolate salient personality variables that may be related to basic skills achievement and retention. The form was pilot tested with nine students for readability and then was submitted to OMB for approval. Items on the interview form included questions concerning the type and number of courses taken in high school, number of hours spent each evening watching television or working on a part-time job, and educational plans for the future. Analysis of these variables was expected to help answer the question, who learns (or retains) basic skills best in what setting? Students completed the interview form during spring 1985.

School Records

Program participation was determined by the course descriptions provided by the school district. The descriptions included the information that "this class is required for college entrance" or "this class is vocational." The student's grade point average, SES (indicated by free or partially paid lunch), gender, race, and grade level were obtained from the district's master pupil data bank.

Sample Selection

Selection of Students

Through a subcontract arrangement, a midwestern urban public school system participated in this research effort. Their participation included selecting a sample of students, securing student and parent cooperation, testing students, and making arrangements for research staff to conduct observations and interviews in classrooms and cooperative work sites.

In the first step of sample selection, the school personnel chose four comprehensive high schools (25 percent of the district's total) that were representative of the geographical distribution of high schools in the city and of the number of students in the city's high schools. In addition, two career education centers (50 percent of the district's total) were selected because they offered vocational education noncooperative courses. In this particular system, vocational education cooperative courses are offered only for the clerical and marketing (distributive) education areas. To obtain a sample of approximately 400 students, the school system required that intact classrooms be selected rather than individual students, using course descriptions to determine if the class represented college preparatory, general education, vocational nonco-op, or vocational co-op subject matter. All student testing and observation were conducted in these classrooms. Table 2 displays the distribution of classrooms and students in the pretest sample for each high school and program area. In this table, schools #1 through #4 represent the comprehensive high schools, whereas schools #5 and #6 represent the career education centers. The key features of the four programs are displayed in table 3. These features help describe the setting in the research question: Who learns basic skills best in which setting?

Student Characteristics

Various demographic characteristics of the students in the total sample are shown in table 4. This table summarizes the students' gender and race within the four educational programs. The preponderance of females in the sample results from the fact that most students in the clerical vocational programs were female, which is typical of students in this occupational area. However, at retention testing, the distribution was more even, as seen in table 5. The even distribution of white and minority youth in this sample at both times reflects the distribution of the races within the particular school system observed. The inclusion of both juniors and seniors in the original sample is a result of several constraints. First of all, in this school system, the vocational co-op courses are designed only for seniors. Therefore, seniors had to be included in all four school programs to enable comparisons of basic skill performance as a

TABLE 2

DISTRIBUTION OF CLASSROOMS AND STUDENTS BY EDUCATIONAL PROGRAM AND HIGH SCHOOL MEMBERSHIP

Educational Programs Subject-Matter Content	Comprehensive High Schools and Career Education Centers (# of classrooms, # of students)						Total Per Program: Number of Classrooms	Total Per Program: Number of Students
	School #1	School #2	School #3	School #4	School #5	School #6		
College Preparatory							4	90
Math		1, 13						
English			1, 26	1, 22				
Social studies	1, 29							
General Education							5	79
Math				2, 22				
English	1, 17		1, 31					
Social studies		1, 9						
Vocational Education-Noncooperative							5	117
Banking & admin. specialist					2, 65			
Department store marketing						2, 28		
Auto technician specialties					1, 24			
Vocational Education-Cooperative							8	139
Cooperative office educ.	1, 20	1, 16	1, 15	1, 14				
Distributive educ.	1, 15	1, 12	1, 28	1, 19				
Total per School: # of classrooms, # of students	4, 81	4, 50	4,100	5,77	3, 89	2, 28	22	425

TABLE 3

PROGRAM COMPARISON OF KEY FEATURES

Key Features	Programs			
	College Preparatory	General Education	Vocational Cooperative	Vocational Noncooperative
Location	Midwest, urban center, high school program within a comprehensive high school	Midwest, urban center, high school program within a comprehensive high school	Midwest, urban center, high school program within a comprehensive high school	Midwest, urban center, high school vocational program within a vocational center
Description	Prepares students for college-level study through the use of a structured academic program. Provides students with the requisite skills and knowledge necessary for success in the college-level academic environment.	Aid students in the development of realistic career and life goals, and helps them gain a broad understanding of the world of work and the various components within it.	Enables students to receive on-the-job training and some classroom education and to prepare for full-time employment.	Permits students to earn academic credit through the practical applications of career principles in a lab setting.
Percentage of time for -Classroom setting -Workplace setting	Classroom: 100% Workplace: 0%	Classroom: 100% Workplace: 0%	Academic Classroom: 23% Vocationally Related Classroom: 23% Vocationally Related Workplace: 54%	Academic Classroom: 50% Vocational Lab and Related Instruction: 50%
Payment	None	None	Minimum or near minimum wage	None
Length of program	4 years	4 years	1 year	2 years

TABLE 3--Continued

Key Features	Programs			
	College Preparatory	General Education	Vocational Cooperative	Vocational Noncooperative
Type of work placement	None	None	On-the-job training (Specific position)	None
Total credits required for graduation	19	17	17	17
Total credits given for program participation	19	17	3.5	6
Type of credits for program participation	Academic, elective	Academic, elective	Vocational	Vocational
Advisory committee	No	No	Yes	Yes

TABLE 4

CHARACTERISTICS OF STUDENTS IN THE LEARNING INTERVAL SAMPLE

Programs	N	Student Characteristics					
		Sex (N)		Race (N)		Grade Level (N	
		Male	Female	White	Minority*	11th	12t
Academic/College Preparatory	74	30	44	44	30	44	30
General Education	50	24	25	26	24	31	19
Vocational Education Noncooperative	91	27	64	33	58	61	30
Vocational Education Cooperative	116	26	90	58	58	0	116
Total number of students	331	108	223	161	170	136	195
Percentage of total		33%	67%	49%	51%	41%	59%

*The majority of minority students who participated in the study were black. Fewer than 10 were of Hispanic or Asian origin.

TABLE 5

CHARACTERISTICS OF STUDENTS IN THE RETENTION INTERVAL SAMPLE

Programs	N	Student Characteristics			
		Sex (N)		Race (N)	
		Male	Female	White	Minority
Academic/College Preparatory	37 (37%)	13 (35%)	24 (65%)	17 (46%)	20 (54%)
General Education	26 (26%)	14 (54%)	12 (46%)	15 (58%)	11 (42%)
Vocational Education Noncooperative	36 (36%)	15 (42%)	21 (58%)	16 (44%)	20 (56%)
Total number of students	99	42	57	48	51
Percentage of total	100%	42%	58%	48%	52%

*The majority of minority students who participated in the study were bla
Fewer than 10 were of Hispanic or Asian origin.

function of program participation (e.g., controlling for age and grade level). Second, a goal of this research effort was to determine students' basic skill performance after the summer vacation in order to examine the retention of basic skills in relation to participation in one of the school programs. Thus, juniors were included in the original sample to ensure the availability of students for testing after summer vacation. After the retention interval the sample size was reduced to 99 students, all of whom were juniors from the beginning sample.

Statistical Analysis

Multiple regression analyses were conducted to determine the degree of relationship between the independent variables and the dependent variables, the mathematics and reading scores, at the end of the learning interval and at the end of the retention interval. A series of correlation matrices was first generated to show intercorrelation of similar variables and identify potential sources of multicolinearity. The sets of variables were then correlated with the dependent measures to show sources of strongest relationship. The results of these two sets of correlations were examined to identify an appropriate number of variables that were not highly correlated with other potential independent variables and that were correlated with the dependent measures.

To obtain regression estimates, a series of simultaneous models was run, beginning with a simple model. At each subsequent stage variables were added that were entered in a hierarchical time-ordered fashion.

To accommodate missing data, a pairwise-deletion correlation matrix was run. This is a correlation matrix that uses all cases for each correlation coefficient that have valid data for both variables. The underlying assumption for this procedure is that the missing data, if present, would not be so different from valid data as to alter the value of the correlation between any two variables. In all cases, only those students were included who had scores for all test times used in the analyses.

CHAPTER 4

RESULTS AND RECOMMENDATIONS

Introduction

This chapter provides the results of the analyses that address the fundamental question of the study: Who learns and retains basic skills best in which setting? All variables in the study are defined in table 1 at the end of chapter 1. The "who" variables are those students at the secondary level identified by gender and race. Additional personal characteristics of the students are socioeconomic status, grade point average, attendance, dependability, quality of work, academic courses taken, vocational courses taken, educational aspiration, part-time job, and hours spent viewing television. The "basic skills" variables are mathematics and reading achievement scores. The "which setting" variables examined four different educational curricular programs: college preparatory, general education, vocational noncooperative education, and vocational cooperative education. Five learning environment characteristics that are amenable to change and can influence performance are examined. These characteristics are initiator, feedback, articulation, mathematics skills usage, and language skills usage. The learning interval is the time from the beginning to the end of the school year (time 1 to time 2). The retention interval is the time from the end of the school year to the end of the summer recess (time 2 to time 3).

Because an objective of this study was to determine how school program factors, learning environmental characteristics and student characteristics and factors relate to basic skill development, these relationships were tested in a series of regression analyses on the learning and retention intervals of the study. In all cases the performance of students in college prep and vocational programs was compared to that of students in the general education program. In the first analysis the effect of program on basic skill achievement was examined. In the second, the influence of gender and race was explored. Last, student characteristics and environmental factors were studied in relation to mathematics and reading achievement.

For the retention interval, seniors were not available for testing, so only scores of those juniors remaining in the study were analyzed. Co-op students were seniors only and thus were not included in the retention analysis. With the deletion of seniors from the test and the loss by attrition of 76 juniors from beginning to end of the study, the sample size decreased from 331 at the end of the school year to 99 at the end of the retention interval. Because the retention interval of the study was constrained by a smaller sample size and thus fewer variables in the regression model, the researchers decided to look at the same regression model for the learning interval.

The chapter is organized into five sections: (1) description of student characteristics, (2) results of the analyses for the learning interval, (3) results of the analyses for the retention interval, (4) summary, and (5) recommendations.

Student Characteristics

The composition of students in the learning interval sample was 22 percent college preparatory, 15 percent general education, 27 percent vocational noncooperative, and 36 percent vocational cooperative. For the retention sample, however, the proportions had changed, largely due to the absence of the co-op group and, to some extent, the absence of seniors from the group. The composition of the retention sample was 37 percent college preparatory, 36 percent vocational nonco-op and 26 percent general education students.

School Course Work

Students were asked to indicate the grade levels in which they had taken any of a variety of courses, including mathematics, English or literature, history or social studies, foreign languages, science, business or office courses, sales or marketing, trade and industry, technical courses, and other vocational or elective courses. A majority of students in all school programs indicated having taken a mathematics course in both of the first 2 years. However, although this trend continued for college preparatory students throughout all 4 years of school, the majority of vocational and general education students (76.1 percent and 57.9 percent, respectively) indicated that they took no math in their senior year.

School Grades

Fifty percent of the college prep students had grades of Bs or better, compared to 27.7 percent of the vocational and 8.7 percent of the general education students.

Television Viewing

Students were asked to indicate how many hours per weekday they spent watching television. Among general education students, 25.8 percent reported watching 4 or more hours of television each weekday, compared to 23.8 percent of vocational and 15.5 percent of college prep students.

Part-Time Work

Vocational students were more likely to be working at a part-time job during the school year. Among the vocational students, 90.3 percent reported holding part-time jobs at the time of the interview; 86.1 percent of the general education students and 76.8 percent of the college prep students reported having a part-time job.

Vocational students were also more likely to work 35 or more hours per week at their part-time jobs. Among vocational students, 10.3 percent reported working at least 35 hours per week, compared to 5.6 percent of the general education and none of the college prep students. College prep students who were employed were more likely to work less than 15 hours per week (26.8 percent) in comparison to vocational (14.4 percent) and general education students (13.9 percent). The results indicated that vocational students spent a proportionally greater amount of time in work situations than did students in other school programs. Since time spent in school for vocational co-op students and time available for study for all vocational students is less than that for students in other programs, school administrators need to be concerned that time spent at the co-op work site help teach students basic skills. Co-op job placements should provide an incentive to the student to increase the basic skills that are relevant to that particular job situation, as well as the basic skills that will be useful in providing the student with a variety of future vocational options.

Learning Interval

This section is divided into three topics: student performance, mathematics learning, and reading learning. Student performance, the first topic, describes students' math achievement and then their reading achievement during the learning interval (time 1 and time 2). The second topic, mathematics learning, presents the results of the regression analyses for the effect of program participation on math achievement followed by the effects of learning environment characteristics and student personal characteristics on math achievement. The third topic, reading learning, presents the results of the regression analyses for the effects of program participation on reading achievement followed by the effects of learning environment characteristics and student personal characteristics on reading achievement.

Student Performance

Mathematics. Table 6 shows the means and standard deviations of students' math scores for the learning interval. Figure 3 displays this information in graphic form. At the beginning of the learning interval the college prep students' mean math score was about 10 points higher than that of vocational co-op students. The vocational nonco-op students mean score was lower than that of

TABLE 6

MEAN AND STANDARD DEVIATION OF MATH TEST SCORES
BY PROGRAM PARTICIPATION AND T[illegible] TIMES
DURING THE LEARNING INTERV[illegible]

Program	N	Time 1		Time 2	
		$\bar{X}$	SD	$\bar{X}$	SD
College Prep	74	39.58	13.28	42.85	14.97
General Education	50	22.65	11.86	28.44	12.59
Vocational Nonco-op	91	26.38	10.88	26.59	12.27
Vocational Co-op	116	29.52	11.24	28.72	11.86

66

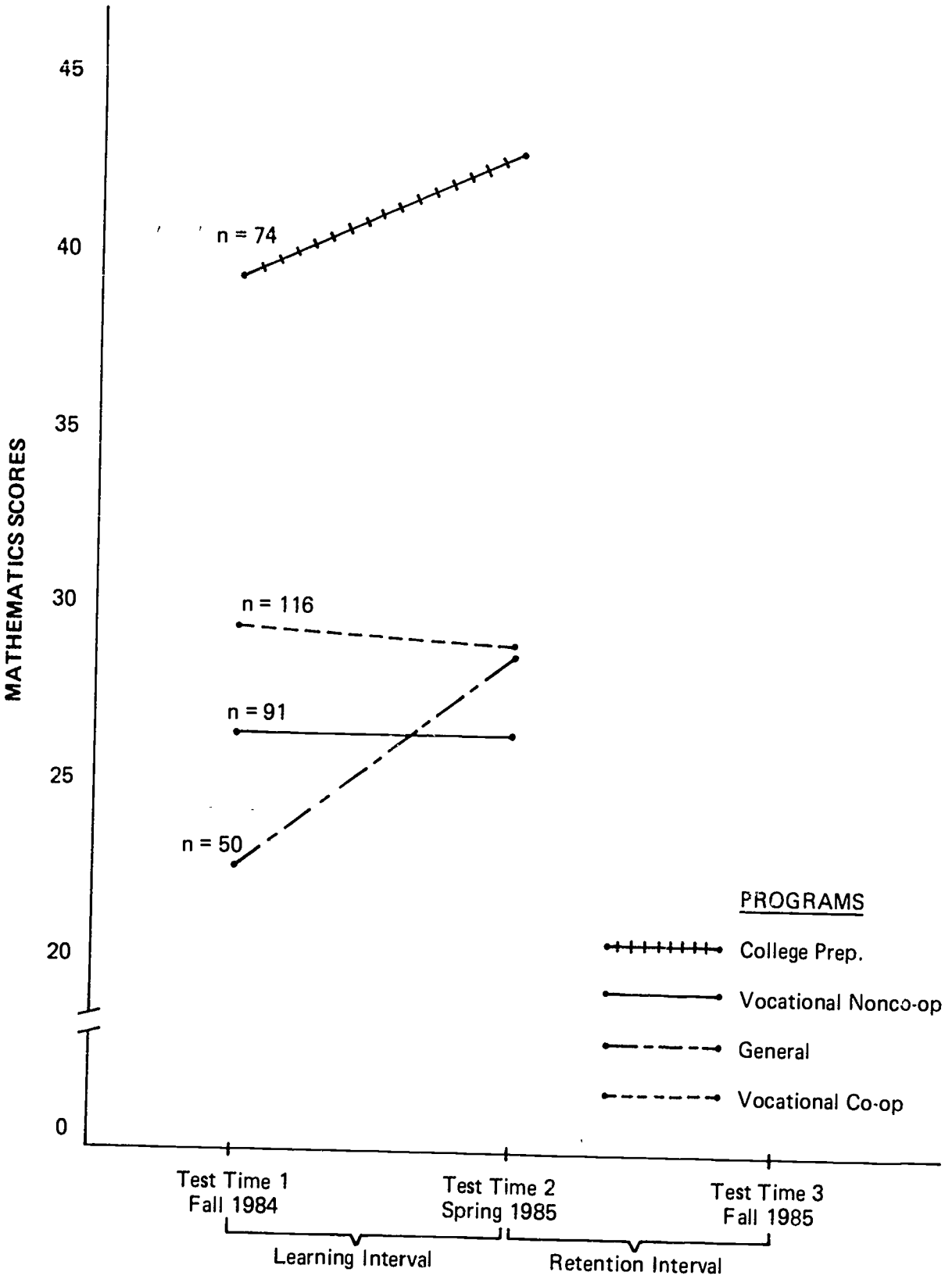

Figure 3. Average mathematics total scores for the learning interval by program (n = 331)

vocational co-op students but higher than the general education students' performance. At the end of the learning interval, the rank order of the program groups' mean performance was college preparatory, vocational co-op, general education, and vocational nonco-op. Although general students increased their mathematics mean scores by about six points from beginning of the school year (time 1) to end of the school year (time 2), and college prep students increased about three points, vocational students did not perform as well. Vocational nonco-op students scores showed a negligible increase and vocational co-op students scores decreased by nearly a point from time 1 to time 2 testing.

Reading. Table 7 shows the means and standard deviations of students' reading scores for the learning interval. Figure 4 displays this information in graphic form. The initial mean reading performance of the four program groups paralleled the math performance with the rank order being college prep, vocational co-op, vocational nonco-op, and general education. At the end of the learning interval this rank order had not changed; however, the mean reading scores decreased over the learning interval for all four educational programs. General education students showed only a negligible decrease, whereas vocational nonco-op students dropped about two points, and vocational co-op about four points. College prep students' mean score decreased about one point.

At all test times, the college preparatory students had mean mathematics and reading scores higher than those of students in the other educational programs. This finding agrees with conclusions drawn by Weber et al. (1982) that secondary vocational students typically perform lower on basic skills attainment than college prep students. Other researchers including Rosenbaum (1976), Oakes (1982), Alexander and McDill (1976), and Gamoran (1986), have also found that being in a college prep program has the strongest impact on math achievement. The issue for this study is not the lower scores for the vocational students, but whether the variables investigated help to explain which students, under what conditions, show improved basic skill performance in vocational programs.

Mathematics Learning

Table 8 represents the results of the regression analysis of the effect of program on mathematics scores at the beginning of the school year, or time 1. Table 9 represents the regression results at the end of the school year, or time 2. To determine the net effect of these program variables on mathematics achievement, the regression at time 2 has controlled for the effect of achievement at time 1. In both models, scores are being compared to those of general education students.

TABLE 7

MEAN AND STANDARD DEVIATION OF READING TEST SCORES
BY PROGRAM PARTICIPATION AND TESTING TIMES
DURING THE LEARNING INTERVAL

Program	N	Time 1		Time 2	
		$\bar{X}$	SD	$\bar{X}$	SD
College Prep	74	40.89	9.62	39.88	13.49
General Education	50	29.83	12.05	29.53	11.38
Vocational Nonco-op	91	32.27	10.00	29.93	11.60
Vocational Co-op	116	35.02	8.87	31.28	11.76

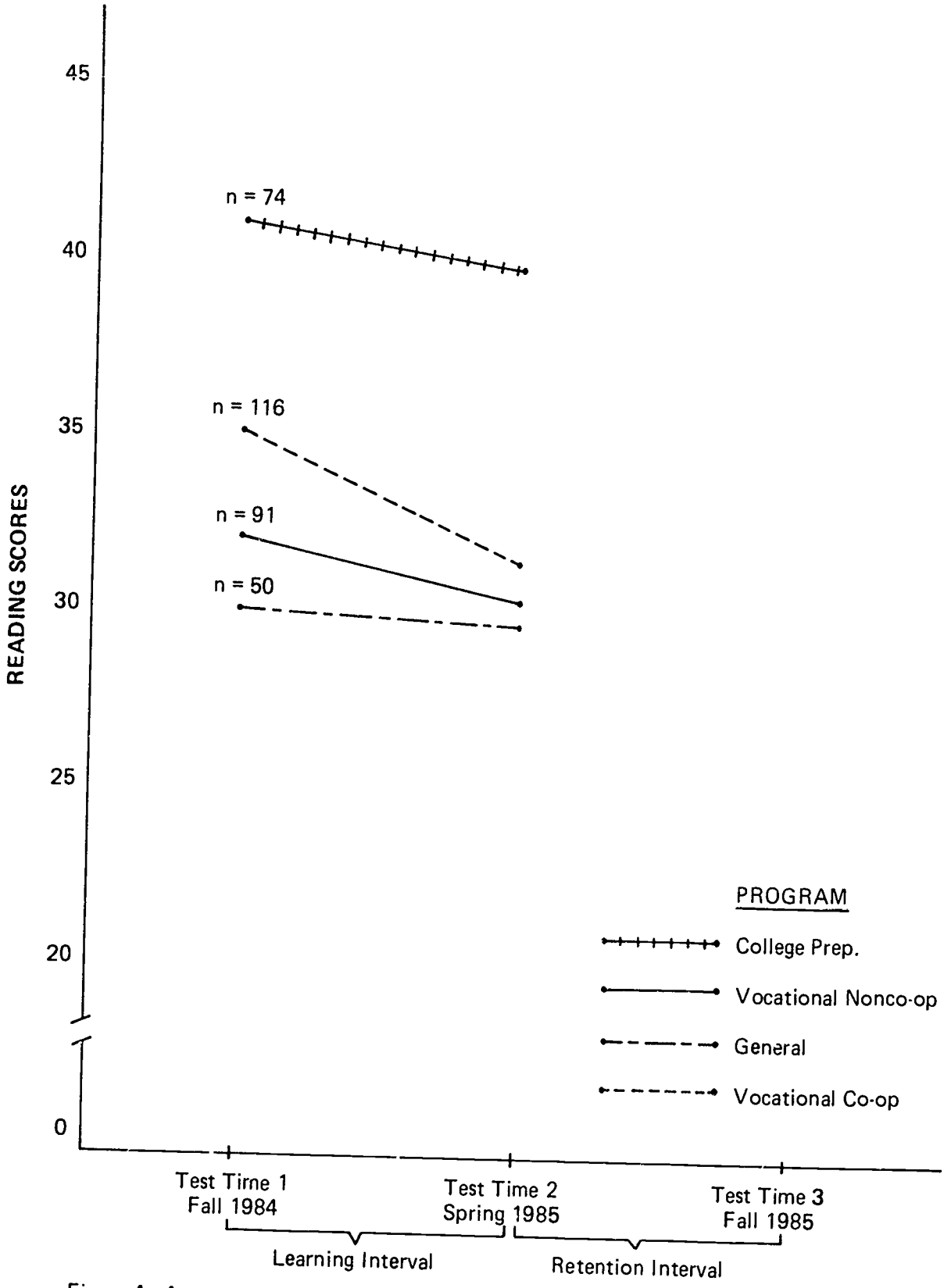

Figure 4. Average reading total scores for the learning interval by program (n = 331)

TABLE 8

RESULTS OF REGRESSION ANALYSES OF MATHEMATICS SCORES AT TIME 1: LEARNING INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=331	White[c] n=162	Minority[d] n=169	Female[e] n=223	Male[f] n=108
College preparatory	9.53****	10.05***	8.35**	7.50**	11.39****
Vocational noncooperative	4.41*	3.70	5.47*	4.50	3.18
Vocational cooperative	2.14	1.34	3.01	1.99	0.38
Socioeconomic status[a]	0.54	1.39	-0.35	-0.11	-0.52
Minority	-7.56****			-6.73****	-9.7****
Male	4.26***	7.07****	2.59		
Grade point average	4.00****	3.45***	4.69****	4.09****	3.75**
Grade level	-0.80	-0.01	-1.32	0.77	-3.82
Educational aspiration	1.38**	0.89	1.41*	1.99**	0.63
Number of academic courses taken	1.38****	1.80***	1.06**	0.85*	2.42****
Number of vocational courses taken	0.54	1.54*	-0.30	0.33	0.91
Part-time job	0.03	0.15	0.32	-0.20	0.30
Television viewing time	-0.75*	-1.71**	-0.37	-0.66	-1.32*

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.

[b]Multiple correlations = 0.52 and adjusted R^2 = 0.50

[c]Multiple correlations = 0.51 and adjusted R^2 = 0.47

[d]Multiple correlations = 0.40 and adjusted R^2 = 0.36

[e]Multiple correlations = 0.48 and adjusted R^2 = 0.45

[f]Multiple correlations = 0.63 and adjusted R^2 - 0.58

*P < .05
**P < .01
***P < .001
****P < .0001

TABLE 9

RESULTS OF REGRESSION ANALYSES OF MATHEMATICS SCORES AT TIME 2: LEARNING INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=331	White[c] n=162	Minority[d] n=169	Female[e] n=223	Male[f] n=108
Mathematics scores, time 1	0.73****	0.76****	0.68****	0.74****	0.72****
College preparatory	-0.53	0.73	-2.50	-2.88	0.93
Vocational noncooperative	-8.85****	-9.00*	-9.51****	-9.38****	-12.00*
Vocational cooperative	-5.20*	-3.42	-6.57*	-6.56**	-5.59
Socioeconomic status[a]	2.17	3.87	1.18	2.37	0.90
Minority	-1.52			-2.19	-2.14
Male	0.15	0.92	0.05		
Grade point average	0.42	1.46	-0.13	0.23	1.25
Grade level	-3.44*	-2.89	-3.43	-3.86*	-3.81
Educational aspiration	0.04	0.27	-0.10	-0.09	-0.02
Number of academic courses taken	.01	-0.51	0.17	0.18	-0.48
Number of vocational courses taken	-0.27	-0.16	-0.43	-0.08	-0.11
Part-time job	-1.85	-1.48	-2.27	-1.43	-0.98
Television viewing time	-0.35	0.63	0.18	0.55	-0.24
Articulation	8.95*	4.54	14.33*	10.71*	14.17

TABLE 9--Continued

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=331	White[c] n=162	Minority[d] n=169	Female[e] n=223	Male[f] n=108
Initiator	-3.67**	-1.72	-5.50***	-3.47*	-5.71
Feedback	2.73**	2.15	3.83**	3.61**	1.56
Mathematics skills usage	0.30	-0.47	1.28	0.94	0.44
Attendance	1.27*	0.78	1.43	0.77	2.54*
Dependability	-0.25	1.83	-1.76	-1.04	1.54
Quality of work	1.37	-0.97	3.08**	2.31*	-1.05

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.
[b]Multiple correlations = 0.68 and adjusted R^2 = 0.65
[c]Multiple correlations = 0.67 and adjusted R^2 = 0.63
[d]Multiple correlations = 0.64 and adjusted R^2 = 0.59
[e]Multiple correlations = 0.70 and adjusted R^2 = 0.67
[f]Multiple correlations = 0.66 and adjusted R^2 = 0.59
*P < .05
**P < .01
***P < .001
****P < .0001

Effects of program participation on math learning. At the beginning of the school year, membership in the college preparatory program was very important in explaining the high math scores. This explanation holds for both white and minority students as well as for male and female learners. Membership in the noncooperative vocational program can also explain the somewhat high math scores found there, both overall and for minority learners. Being a minority depresses the math scores for both males and females. Being a male, especially a white student, explains high math scores at the beginning of the school year.

At the end of the school year (time 2), after controlling for initial math performance, the college preparatory students performed equally as well as the general education students on math items. However, being in a noncooperative vocational program markedly depressed the students' math performance, especially for minority and female students. Being in a cooperative vocational program also depressed the students' math scores, but to a lesser extent than the nonco-op vocational program. At the end of the school year neither the race nor the sex of the student alone explains the change in math performance. With this sample of students and model, it appears that being minority and female in a vocational program resulted in lower math skills achievement relative to the performance of students in the general education program.

Mathematics learning regressions for other student characteristics and environmental factors (tables 8 and 9). Other relationships tested in regression analyses were student personal factors and environmental factors:

- Grade point average--A high grade point average for both sexes and races is associated with high math scores at the beginning of the school year. However, at the end of the learning interval, controlling for initial math performance, grade point average does not explain math performance.

- Socioeconomic status--this variable, as measured in this study, did not explain math performance either at the beginning of the school year or after the learning interval.

- Part-time job--Holding a part-time job does not seem to be correlated with math scores at the beginning of the school year or at the end of the learning interval. Although vocational students were more likely to be working at a part-time job during the school year, it apparently had no effect on math skill achievement.

- Educational aspirations--At the beginning of the year, having higher educational aspirations was positively related to math performance for the total group, especially for minorities and females. Having higher educational aspirations was not related to math learning.

- Total academic courses taken--At the beginning of the year, a higher number of academic courses taken was correlated with a higher math score for all four subgroups. However, the number of total academic courses was not correlated with math scores obtained after the learning interval. If the courses taken had been limited to total mathematics courses, the results might have shown a relationship.

- Total vocational courses--At the beginning of the school year, the number of vocational courses taken was not correlated with mathematics performance for any subgroup except for white students. The higher the number of vocational courses taken during the learning interval, the lower were the math scores at time 2.

- Television viewing hours--The number of hours spent watching television was negatively related to mathematics achievement at the beginning of the school year. The more hours spent watching television, the lower were the scores, especially for white and male students. However, the number of television viewing hours was not related to math skills at the end of the learning interval.

- Grade level--When used as a control variable at time 2, being a senior resulted in lower mathematics scores for all students, particularly for female students. One explanation for this may be that at the end of the year seniors had lost interest in school and testing and thus performed poorly.

- Articulation--For all students, articulation was positively related to mathematics achievement at the end of the school year, especially for minority and female students. These results are consistent with those of previous studies (Johnson and Johnson 1985) which reported that cooperative efforts promoted greater achievement.

- Initiation--During the learning interval, the more tasks that were introduced by people other than the student, the lower were the mathematics scores, especially for minority and female students. This finding agrees with findings from other studies (Lezotte et al. 1980; Brookover et al. 1979, Schroder 1973; and Marshall and Weinstein 1984) indicating that students who have the independence to initiate their activities tend to achieve more.

- o Feedback--For all students feedback was positively related to mathematics achievement at the end of the learning interval, especially for minority and female students. This supports previous findings by Berliner (1984) and others that appropriate use of feedback enhances achievement.

Summary. In general, the more others initiated tasks (e.g., told students exactly what to do) and the less articulation (e.g., fewer cooperative learning efforts) that was present in the setting, the lower were the mathematics scores for the learning interval. The presence of feedback was associated with increased math scores. The effects of these three variables were greatest for female and minority students. During the learning interval there were fewer effects for males' math scores. In fact, none of the variables associated with female math performance was statistically significant for males. It does appear, however, that attending class is important for all students but especially for males, as those who attended demonstrated slightly higher math performance.

Reading Learning

Effects of program participation on reading. Regression analysis scores were also completed for reading achievement at times 1 and 2. At the beginning of the school year (time 1), membership in college preparatory and vocational nonco-op programs, especially for minority students, helped explain the higher reading scores (table 10). At the end of the school year (time 2), however, membership in the vocational nonco-op program markedly depressed the reading scores when compared to student performance in the general education program (table 11). The lower performance was evident for both races and sexes. Membership in the cooperative vocational program during the learning interval also depressed reading scores, but not significantly.

An analyses of the reading scores by gender and race was completed for times 1 and 2. At the beginning of the school year (time 1), being a minority markedly depressed the reading score. This was true for both males and females. At the end of the school year, controlling for initial reading performance, being a minority did not explain reading performance when compared to general education students. Although significant effects for gender were not noted at the beginning of the school year, after the learning interval males had lower reading scores relative to females in all educational programs, agreeing with previous findings (Hogrebe, Nist, and Newman 1985).

Reading learning regression analyses for other student characteristics factors and environmental factors (tables 10 and 11). Other relationships tested in regression analyses were student personal factors and environmental factors:

TABLE 10

RESULTS OF REGRESSION ANALYSES OF READING SCORES AT TIME 1: LEARNING INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=331	White[c] n=161	Minority[d] n=170	Female[e] n=223	Male[f] n=108
College preparatory	4.64**	3.24	7.11**	2.97	5.36*
Vocational noncooperative	3.38*	2.44	4.51*	2.04	3.88
Vocational cooperative	1.42	0.57	1.69	0.75	-0.26
Socioeconomic status[a]	0.24	2.20	-0.45	-0.44	-0.14
Minority	-5.48****			-4.89**	-7.20***
Male	0.48	1.28	-0.69		
Grade point average	2.62****	1.60	3.45****	2.25**	3.04**
Grade level	-1.77	-1.74	-1.13	-0.56	-4.12
Educational aspiration	1.02*	1.66**	0.23	1.47**	0.38
Number of academic courses taken	1.53****	1.20**	1.92****	1.06**	2.62****
Number of vocational courses taken	-0.31	-0.46	-0.22	-0.18	-0.44
Part-time job	-1.37	-2.33	-0.71	-2.08	-0.83
Television viewing time	-0.12	-0.57	0.32	0.15	-0.77

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.

[b]Multiple correlations = 0.36 and adjusted R^2 = 0.34

[c]Multiple correlations = 0.34 and adjusted R^2 = 0.28

[d]Multiple correlations = 0.34 and adjusted R^2 = 0.29

[e]Multiple correlations = 0.32 and adjust i R^2 = 0.28

[f]Multiple correlations = 0.52 and adjusted R^2 - 0.45

*P < .05
**P < .01
***P < .001
****P < .0001

TABLE 11

RESULTS OF REGRESSION ANALYSES OF READING SCORES AT TIME 2: LEARNING INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=331	White[c] n=161	Minority[d] n=170	Female[e] n=223	Male[f] n=108
Reading scores, time 1	0.70****	0.62****	0.82****	0.74****	0.70****
College preparatory	-3.65	-2.86	-5.49	0.74	-4.04
Vocational noncooperative	-7 36***	-11.77**	-5.70*	-5.84'	-12.16*
Vocational cooperative	-3.02	-7.27	-0.50	-1.83	-11.23
Socioeconomic status[a]	1.45	0.83	1.49	1.83	1.25
Minority	-0.01			-1.62	1.47
Male	0.37	-1.38	2.98		
Grade point average	1.25	2.38	0.54	1.81	0.34
Grade level	-2.93	0.31	-4.78*	-5.21*	0.88
Educational aspiration	0.34	0.00	0.53	0.33	0.09
Number of academic courses taken	-0.33	-0.90	-0.46	-0.11	-0.94
Number of vocational courses taken	-0.23	-0.32	0.00	-0.25	-0.29
Part-time job	-3.56**	-2.43	-4.12*	-2.80	-1.91
Television viewing time	-0.26	-0.32	-0.17	-0.20	-0.07
Articulation	8.29	10.46	10.24	7.34	27.75*

TABLE 11--Continued

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=331	White[c] n=161	Minority[d] n=170	Female[e] n=223	Male[f] n=108
Initiator	-4.26**	-2.20	-6.10**	-4.33**	-5.27
Feedback	4.56****	3.97*	5.55***	6.02****	2.43
Language skills usage	4.64**	3.23	6.03**	5.20**	1.31
Attendance	0.31	-0.54	0.67	-0.81	3.62**
Dependability	-0.64	0.64	-2.22*	-1.29	0.36
Quality of work	1.01	1.37	1.31	1.04	0.56

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.
[b]Multiple correlations = 0.51 and adjusted R^2 = 0.48
[c]Multiple correlations = 0.52 and adjusted R^2 = 0.45
[d]Multiple correlations = 0.56 and adjusted R^2 = 0.50
[e]Multiple correlations = 0.56 and adjusted R^2 = 0.52
[f]Multiple correlations = 0.54 and adjusted R^2 = 0.43
*P < .05
**P < .01
***P < .001
****P < .0001

- Grade point average--At the beginning of the school year, the higher the GPA, the higher was the reading score, especially for minority students. Higher GPA's resulted in slightly higher reading scores for males and females. At the end of the learning interval, however, no significant effect of GPA was found on reading scores.

- Socioeconomic status--As with the case of math performance, socioeconomic status, as measured by this study, did not explain reading performance either at the beginning of the school year or after the learning interval.

- Part-time job--There was no effect on reading scores at the beginning of the year. However, holding a part-time job during the school year had a negative effect on reading scores during the learning interval. Minority students who worked during the school year tended to get lower reading scores. As indicated in previous findings, time spent on part-time work may have a negative effect on achievement (Greenberger 1983, Finch and Mortimer 1985). Since more than half the teenage population works (Finch and Mortimer 1985) this relationship needs to be taken into consideration by educators.

- Educational aspirations--The educational aspirations variable was related to reading scores only at the beginning of the year, with greater educational aspirations resulting in higher reading scores, especially for white and female students.

- Total academic courses--Students in all subgroups who had taken more academic courses had higher reading scores, but only at the beginning of the school year. This relationship was not present after the learning interval.

- Vocational courses--A greater number of vocational courses taken was associated with slightly depressed reading scores at both the beginning and end of the learning interval for all students. The effect was not significant.

- Television viewing hours--No significant effects were noted for hours spent watching television.

- Environmental variables--Overall during the learning interval, the more tasks that were self-initiated, the higher the language skill usage rating, and the higher the feedback, the higher was the reading score. The effects were very strong, especially for the feedback variable. These results are consistent with findings by Lezotte et al. (1980), Brookover et al. (1979), Schroder (1973), Marshall and Weinstein 1984; and Berliner 1984) that self-initiation of tasks and greater feedback result in greater

achievement. Across subgroups, higher feedback was strongly related to higher reading scores, but significantly more so for females than males. For both minority and white students, greater feedback was related to positive scores, but more strongly for minority students. Articulation (i.e., student's work was dependent on others in the setting) increased reading scores. The effect was significant only for males, however.

For minorities, the more others initiated tasks and the higher the teacher dependability rating, the lower was the reading score. Conversely, the higher the language skill usage and feedback, the higher was the reading score. A similar pattern was noted for females except that no effect was noted for dependability. The only effect for males during the learning interval was that higher attendance resulted in higher reading scores.

Retention Interval

The primary purpose of this report is to present the results of the retention interval of the study of basic skills achievement. To determine who retains basic skills best in what setting, regression analyses were conducted of school program, environmental factors, and student characteristics for both mathematics and reading.

As noted earlier, this group includes only juniors who were available for retention testing. Because seniors were not available for retention testing (including the vocational co-op students who were all seniors), all seniors are dropped from the retention analysis. In addition, 76 juniors were lost to the retention portion of the study for various reasons, such as moving, leaving school, or absence during testing times. Thus, the retention sample was reduced in size from the sample analyzed in the learning interval.

Significant differences were found between juniors completing the retention testing (n=99) and juniors lost to the study (n=76). On time 1 and time 2 test scores, the retention group achieved means significantly higher than means of the nonfollow-up group in each case, except for reading at time 2. Also, grade point averages were lower for the nonfollow-up students. These differences suggest that the students with higher grade point averages and test scores remained in the study.

If the nonfollow-up students had stayed in the study, one would expect their scores to improve, just by chance. Higher and lower scoring students would both regress toward the mean. Thus, the loss of the lower-scoring students may explain the reduction in retention performance.

This section is divided into three topics: student performance, mathematics retention, and reading retention. Student performance, the first topic, describes students' math performance and then their reading performance during the retention interval (time 2 to time 3). The second topic, mathematics retention presents the results of the regression analyses for the effects of program participation on math retention, followed by the effects of learning environment characteristics and student personal characteristics on math retention. The third topic, reading retention, presents the results of the regression analyses for the effects of program participation on reading retention followed by the effects of learning environment characteristics and student personal characteristics on reading retention.

Student Performance

Mathematics. Table 12 gives the means and standard deviations of students' math scores (n=99) for the retention interval, while figure 5 presents the means graphically. At the beginning of the summer recess, vocational nonco-op students' mean math score was nearly 11 points lower than that of college prep students and about 2 points lower than that of general education students. At the end of the retention interval, the rank order of the program groups' mean performance was college prep, vocational nonco-op and general education. However, the general education mean score was only .02 points lower than that of vocational nonco-op.

Over the summer recess, vocational nonco-op students improved mathematics test scores by nearly one point while college prep students increased scores by nearly two points. General education students' scores dropped by less than two points. As with scores in the learning interval, college prep students' performance in mathematics was several points higher than that of students in other programs.

Reading. Table 13 shows the means and standard deviations of students reading scores for the learning interval. Figure 6 describes the information graphically. At the beginning of the retention phase, vocational nonco-op students performed nearly five points lower than college prep students and nearly four points higher than general education students. At the end of the retention period, however, the rank order was college prep, general education, and vocational education. While college prep and general education students both improved mean scores by more than three points, vocational nonco-op students' mean score dropped by about the same amount.

Mathematics Retention

Table 14 shows the results of the regression analyses of the effect of program and other variables on mathematics scores at the beginning of the retention interval (time 2). Table 15 shows the

TABLE 12

MEAN AND STANDARD DEVIATION OF MATHEMATICS TEST SCORES BY PROGRAM PARTICIPATION AND TESTING TIMES FOR THE RETENTION INTERVAL

Program	N	Time 2		Time 3	
		$\bar{X}$	SD	$\bar{X}$	SD
College Prep	37	39.59	14.48	41.03	14.34
General Education	26	30.72	13.48	29.12	12.28
Vocational Nonco-op	36	28.69	12.31	29.14	11.65

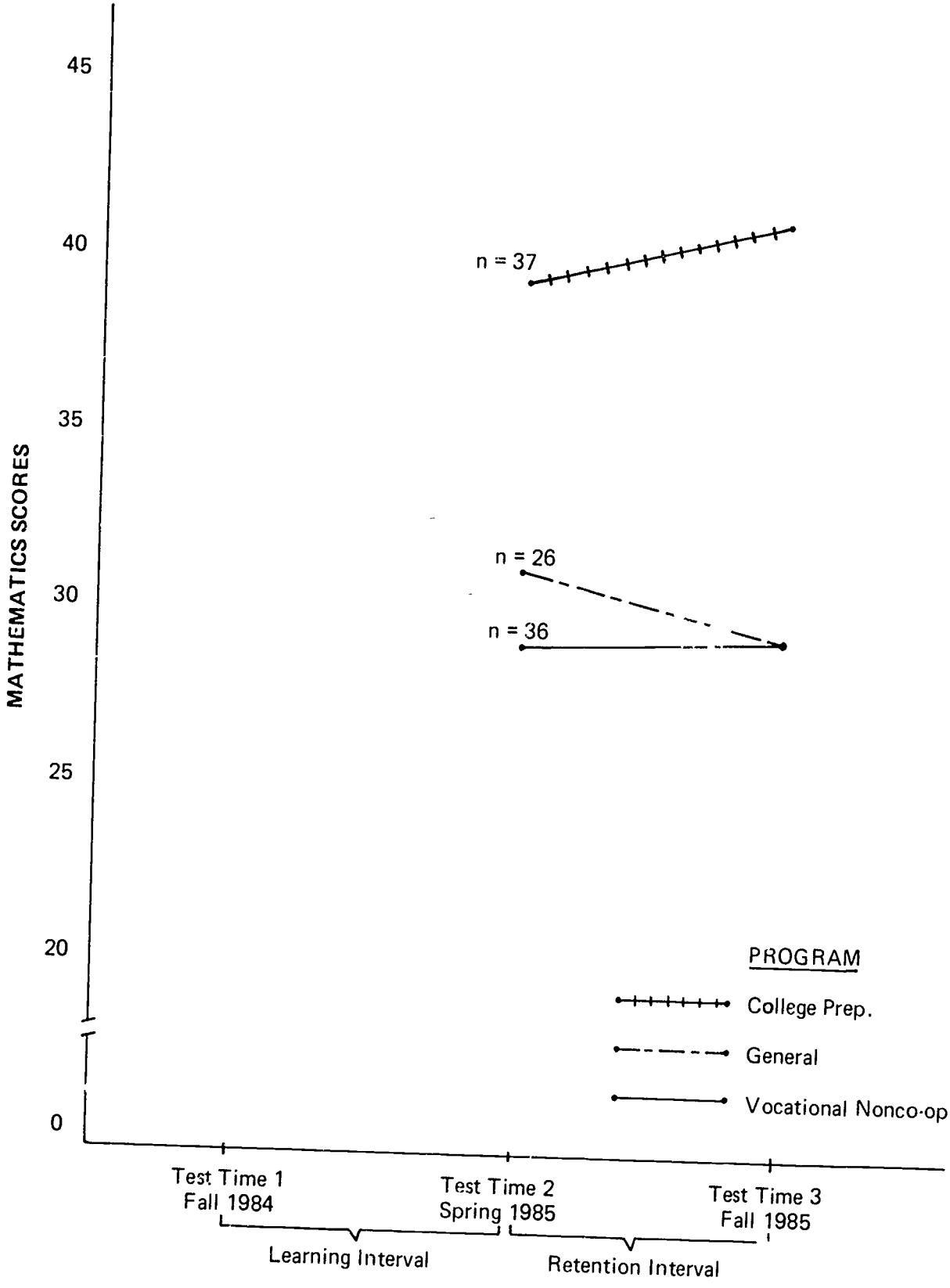

Figure 5. Average mathematics total scores for the retention interval by program (n = 99)

TABLE 13

MEAN AND STANDARD DEVIATION OF READING TEST SCORES
BY PROGRAM PARTICIPATION AND TESTING TIMES
FOR THE RETENTION INTERVAL

Program	N	Time 2		Time 3	
		$\bar{X}$	SD	$\bar{X}$	SD
College Prep	37	38.14	14.47	41.70	9.72
General Education	26	29.58	11.29	33.00	10.12
Vocational Nonco-op	36	33.44	10.48	30.50	9.57

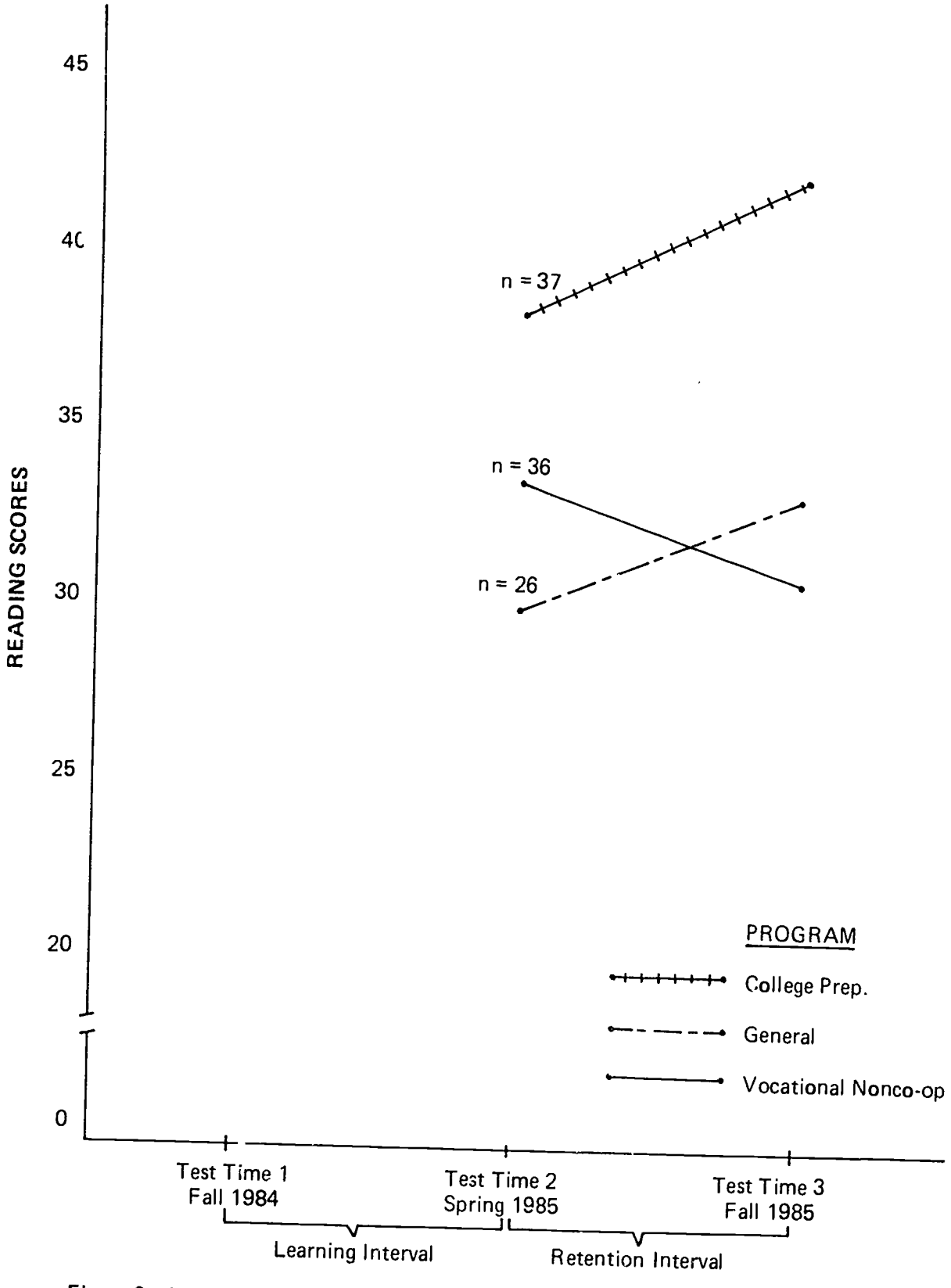

Figure 6. Average reading total scores for the retention interval by program (n = 99)

TABLE 14
RESULTS OF REGRESSION ANALYSES OF MATHEMATICS SCORES AT TIME 2: RETENTION INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=99	White[c] n=48	Minority[d] n=51	Female[e] n=57	Male[f] n=42
College preparatory	5.87	11.39	3.04	-2.06	15.81*
Vocational noncooperative	-5.58	-5.67	-5.04	-11.69	-8.81
Socioeconomic status[a]	2.38	3.44	0.07	2.96	-6.11
Minority	-4.16			-4.02	-8.32*
Male	6.56*	12.23**	2.80		
Grade point average	5.02*	6.72*	2.82	1.19	-1.42
Educational aspiration	-1.17	-1.18	-1.66	1.57	-2.36
Number of academic courses taken	2.95**	0.83	3.26*	1.58	4.40*
Number of vocational courses taken	1.42	3.86*	-0.37	1.27	4.75**
Part-time job	-0.88	1.55	1.27	-5.10	6.63
Television viewing time	-0.93	-1.83	-0.36	-1.21	-0.53
Articulation	14.15	29.89	3.65	28.09	12.02
Initiator	-8.01	-11.55	-7.86	-10.73	-18.55*
Feedback	3.21	2.37	7.24	0.49	7.17*
Attendance	1.22	1.02	0.56	-0.29	3.93*
Dependability	-1.38	3.70	-2.41	-2.65	4.68
Quality of work	4.11	-2.52	6.96	9.09*	2.25

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.

[b]Multiple correlations = 0.51 and adjusted R^2 = 0.41
[c]Multiple correlations = 0.62 and adjusted R^2 = 0.42
[d]Multiple correlations = 0.52 and adjusted R^2 = 0.28
[e]Multiple correlations = 0.52 and adjusted R^2 = 0.32
[f]Multiple correlations = 0.80 and adjusted R^2 = 0.67

*P < .05
**P < .01
***P < .001
****P < .0001

TABLE 15

RESULTS OF REGRESSION ANALYSES OF MATHEMATICS SCORES AT TIME 3: RETENTION INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=99	White[c] n=48	Minority[d] n=51	Female[e] n=57	Male[f] n=42
Mathematics scores, time 2	0.65****	0.39**	0.85****	0.60****	0.35
College preparatory	6.47*	14.37**	4.06	2.56	14.56*
Vocational noncooperative	-0.92	-2.37	0.36	-1.81	-5.69
Socioeconomic status[a]	2.74	1.42	1.79	1.32	2.50
Minority	-3.93			-4.10	-7.99
Male	2.30	7.41*	2.51		
Grade point average	1.22	1.82	1.13	-1.55	2.11
Educational aspiration	-0.67	-1.50	-1.17	-0.40	-0.74
Number of academic courses taken	1.29	1.70	0.02	0.74	3.24
Number of vocational courses taken	1.33	3.76*	0.71	2.33*	2.40
Part-time job	2.99	2.82	5.85*	1.00	5.91
Television viewing time	-0.23	-1.29	0.89	0.05	-0.14
Articulation	3.46	16.42	-1.45	-9.75	9.60
Initiator	-7.22*	-8.40	-2.71	-1.34	-22.09*
Feedback	-1.55	-2.57	0.15	-1.43	0.89

Table 15--Continued

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=99	White[c] n=48	Minority[d] n=51	Female[e] n=57	Male[f] n=42
Attendance	-1.05	-1.62	0.20	-0.47	-1.59
Dependability	0.53	0.50	0.36	-1.20	5.28*
Quality of work	2.19	1.71	1.44	7.42**	-0.78

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.
[b]Multiple correlations = 0.76 and adjusted R^2 = 0.70
[c]Multiple correlations = 0.78 and adjusted R^2 = 0.66
[d]Multiple correlations = 0.85 and adjusted R^2 = 0.78
[e]Multiple correlations = 0.82 and adjusted R^2 = 0.74
[f]Multiple correlations = 0.82 and adjusted R^2 = 0.69
*P < .05
**P < .01
***P < .001
****P < .0001

results of a similar regression on mathematics scores at the end of the summer, which is after the retention interval. To determine the net effect of the independent variables on mathematics retention (time 3), the regression analyses controlled for the effect of the scores at time 2, the end of the school year.

At the beginning of the retention interval (time 2), membership in college preparatory or nonco-op vocational programs was not advantageous relative to the students in the general education program. Males, especially white ones, appear to be more proficient in mathematics relative to the performance of females. Minority males, however, were more likely to have depressed math performance than minority females.

After the retention interval, membership in a college preparatory program, especially for white males, has a greater effect on math retention relative to general education students' math performance. Vocational nonco-op students did not score significantly higher or lower relative to general education students. Being a minority did not affect the mathematics retention. Being a white male is associated with higher math retention performance. The higher performance of males at the end of the retention interval agrees with findings that men by age 17 may have greater spatial visualization abilities (Levini and Ornstein 1983).

Math retention regression for other student characteristics and environmental factors (tables 14 and 15). Other relationships tested in regression analyses were student factors and environmental factors:

- Part-time job--Holding a part-time job does not seem to be correlated with mathematics retention, except in the case of minority students, who had slightly higher retention scores than minority students without jobs. Thus, while previous findings suggest that holding a part-time job is negatively related to achievement (Greenberger 1983, Finch and Mortimer 1985), in this sample and for minority students, holding a part-time job appears to be associated with greater retention of math performance.

- Educational aspirations--Having higher educational aspirations was not related to retention for any group.

- Total academic courses taken--At the beginning of the retention interval, a higher number of academic courses was correlated with a higher math score, especially for minorities and female students. However, the number of academic courses was not correlated with scores at the end of the retention interval. If the courses taken had been limited to total mathematics courses, the results might have been different.

- Total vocational courses--At the beginning of he retention interval, the number of vocational courses taken was not correlated with mathematics scores for all students. However, for students who were white and male, math scores were slightly higher for the total number of vocational courses taken. After the retention interval, the total number of vocational courses taken during the learning interval was positively related to higher math scores at the end of the retention interval for female and white students only.

- Television viewing hours--The number of television viewing hours was not related to mathematics retention.

- Articulation--Articulation was not related to mathematics achievement at the beginning or end of the retention interval.

- Initiation--In general, the more others initiated tasks during the learning interval, the lower the retention rate was, especially for male students. Studies by Lezotte et al. (1980), Brookover et al. (1979), Schroder (1973), and Marshall and Weinstein (1984) agree with this finding that self-initiated tasks are related to greater achievement.

Summary. The retention of mathematics performance (relative to the math performance of general education students) is best achieved by students who scored high on the previous math test (at time 2) and students who were members in the college prep program. Mathematics retention is also enhanced for white males and males in the college prep program. Those learning environments where students were permitted to initiate the tasks showed that this factor had a positive effect on math retention. This agrees with previous findings (de Charms 1972, 1976) that retention is enhanced when students believe they control their performance by their efforts.

Reading Retention

Tables 16 and 17 show the results of regression analyses of the effect of program and other variables on reading retention scores at time 2 and time 3 respectively. As in the mathematics retention analyses, the reading regression analyses controlled for the effect of scores at time 2, the end of the school year. Again, the reading retention sample included only juniors (n=99). At the beginning of the retention interval, vocational noco-op students and college prep students did not score significantly higher or lower than general students.

An analysis of the reading scores by gender and race was completed for the retention interval. At the end of the school year (time 2), scores of the vocational nonco-op subgroups were

TABLE 16
RESULTS OF REGRESSION ANALYSES OF READING SCORES AT TIME 2:
RETENTION INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=99	White[c] n=48	Minority[d] n=51	Female[e] n=57	Male[f] n=42
College preparatory	4.59	3.42	-4.89	-6.64	17.60*
Vocational noncooperative	-4.44	-12.51	0.91	-8.91	4.37
Socioeconomic status[a]	2.34	6.09	-0.83	1.20	-2.03
Minority	-1.53			-2.41	-5.69
Male	1.75	-0.41	3.90		
Grade point average	6.52**	6.35	7.02*	3.18	6.18
Educational aspiration	0.36	0.79	1.33	3.34	-1.58
Number of academic courses taken	0.58	-1.13	2.43	-0.51	3.56
Number of vocational courses taken	-0.18	-0.64	0.42	-1.18	3.52
Part-time job	-3.66	-7.09	-2.37	-5.54	-3.71
Television viewing time	-1.52	0.18	-1.74	-2.27	0.36
Articulation	11.62	45.48	2.53	3.97	-6.01
Initiator	-8.99	-7.37	0.28	-8.33	-27.98*
Feedback	1.75	-0.97	6.45	1.76	2.82
Attendance	-0.88	-0.83	-2.59	-3.24	0.96
Dependability	-1.67	-2.73	-0.72	1.16	-2.70
Quality of work	2.21	4.12	-0.79	3.06	5.92

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.

[b]Multiple correlations = 0.32 and adjusted R^2 = 0.18
[c]Multiple correlations = 0.50 and adjusted R^2 = 0.23
[d]Multiple correlations = 0.40 and adjusted R^2 = 0.12
[e]Multiple correlations = 0.41 and adjusted R^2 = 0.17
[f]Multiple correlations = 0.54 and adjusted R^2 = 0.24

*p < .05
**p < .01
***p < .001
****p < .0001

TABLE 17

RESULTS OF REGRESSION ANALYSES OF READING SCORES AT TIME 3: RETENTION INTERVAL

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=99	White[c] n=48	Minority[d] n=51	Female[e] n=57	Male[f] n=42
Reading scores, time 2	0.42****	0.29*	0.46****	0.39***	0.49**
College preparatory	4.26	11.26*	0.43	4.02	4.08
Vocational noncooperative	-5.93	-6.20	-3.69	-1.78	-14.65
Socioeconomic status[a]	2.56	1.49	0.23	-0.25	3.78
Minority	-2.22			-1.32	-2.50
Male	-1.70	1.98	-2.22		
Grade point average	1.78	1.83	0.22	2.07	4.41
Educational aspiration	-0.46	-0.90	-1.44	-0.82	0.07
Number of academic courses taken	1.24	0.70	0.86	0.58	2.22
Number of vocational courses taken	0.75	1.59	0.41	0.87	1.29
Part-time job	0.44	-0.63	3.85	1.90	-1.98
Television viewing time	0.01	-1.(	1.43	0.62	-0.30
Articulation	2.41	14.98	1.90	3.98	18.19
Initiator	-4.96	-9.00	2.66	1.96	-1(
Feedback	-0.29	-2.89	5.17*	1.73	1.68
Attendance	-1.31	-1.49	-0.69	0.37	-5.02*

Table 17--Continued

Independent Variable	Parameter Estimate for the Model (Beta Weights)				
		Race		Gender	
	All Cases[b] n=99	White[c] n=48	Minority[d] n=51	Female[e] n=57	Male[f] n=42
Dependability	-0.05	-0.72	0.22	-2.52	3.12
Quality of work	2.08	1.40	2.89	3.11	0.15

[a]Socioeconomic status was determined by the qualification for reduced or free lunch.
[b]Multiple correlations = 0.59 and adjusted R^2 = 0.49
[c]Multiple correlations = 0.67 and adjusted R^2 = 0.49
[d]Multiple correlations = 0.70 and adjusted R^2 = 0.55
[e]Multiple correlations = 0.60 and adjusted R^2 = 0.43
[f]Multiple correlations = 0.74 and adjusted R^2 - 0.56
*P < .05
**P < .01
***P < .001
****P < .0001

not significantly different from those of general or college prep students, except for male college prep students. These students had scores slightly higher than those of general students (table 10).

At the end of the retention interval (time 3), scores of college prep students and vocational nonco-op students were not significantly higher or lower than those of general students. The same was true for race and gender except for white college prep students, whose scores were slightly higher (table 11).

Reading retention regression analyses for other student factors and environmental factors. Regression analyses were also completed for student and environmental variables:

Grade point average--While higher GPAs resulted in higher reading scores at time 2, no significant effects of GPA were found on retention reading scores at time 3.

No significant differences were noted at either the beginning (time 2) or the end (time 3) of the retention interval for part-time job, educational aspirations, number of academic or vocational courses taken, television viewing time, articulation, initiator, feedback, attendance, dependability or quality of work.

Summary

Figures 7 and 8 provide a summary of the factors that are associated with "who learns and retains mathematics (figure 7) and reading (figure 8) skills best in what setting". The figures group the variables by program participation, learning environment characteristics, and student personal characteristics. A "+" symbol indicates a positive effect of the factor on the skill ($p < .05$) and a "-" symbol indicates a negative effect of the factor on the skill ($p < .05$). An "x" symbol indicates that the factor was not available for analysis. The left side of each figure represents the effects for the learning interval and the right side indicates the effects for the retention interval.

For the Learning Interval

With regard to relationships between basic skill learning and educational program, vocational education students had lower math and reading achievement when compared to general education students. This finding was particularly evident for minorities and females. Similar findings were obtained for vocational co-op students, except that they did not have lower reading scores in comparison with general education students.

WHAT BASIC SKILL?
MATHEMATICS

WHEN?
LEARNING INTERVAL

WHEN?
RETENTION INTERVAL

WHO?					FACTORS	WHO?				
All Stud.	Race		Gender		(Compared to general education students)	All Stud.	Race		Gender	
	W	M	F	M			W	M	F	M
					Where skill learned/retained					
-	-	-	-	-	College preparatory program	+	+			+
-		-	-		Vocational nonco-op program					
					Vocational co-op program	x				
					Under what learning conditions					
-		-	-		Math skill usage					
+		+	+		Initiator (others)	-				-
+		+	+		Feedback					
					Articulation (cooperation)					
					With what background, experience and attitudes					
+	+	+	+	+	Previous math achievement	+	+	+	+	
					SES					
					GPA					
					No. academic courses taken					
-			-		No. vocational courses taken		+		+	
					Being a senior (grade level)	x				
					Holding part-time job			+		
					Hours watching television					
					Educational aspirations					
+				+	Attendance					
					Dependability					+
		+	+		Quality of work				+	

KEY: + = statistical positive effect, $p < .05$
- = statistical negative effect, $p < .05$
x = factor not available for analysis

Figure 7. Summary of factors associated with "who learns and retains mathematics skills best in what setting."

WHAT BASIC SKILL?
READING

WHEN?
LEARNING INTERVAL

WHEN?
RETENTION INTERVAL

WHO?					FACTORS	WHO?				
All Stud.	Race W	Race M	Gender F	Gender M	(Compared to general education students)	All Stud.	Race W	Race M	Gender F	Gender M
					Where skill learned/retained					
-	-	-	-	-	College preparatory program		+			
					Vocational nonco-op program					
					Vocational co-op program	x				
					Under what learning conditions					
+		+	+		Reading skill usage					
-		-	-		Initiator (others)					
+	+	+	+		Feedback			+		
				+	Articulation (cooperation)					
					With what background, experience and attitudes					
+	+	+	+	+	Previous reading achievement	+	+	+	+	+
					SES					
					GPA					
					No. academic courses taken					
					No. vocational courses taken					
		-	-		Being a senior (grade level)	x				
-		-			Holding part-time job					
					Hours watching television					
					Educational aspirations					
				+	Attendance					
		-			Dependability					-
					Quality of work					

KEY: + = statistical positive effect, $p < .05$
- = statistical negative effect, $p < .05$
x = factor not available for analysis

Figure 8. Summary of factors associated with "who learns and retains reading skills best in what setting."

With regard to learning environment characteristics, the following relationships were found:

- Lower articulation (cooperative learning efforts) was associated with lower math scores.
- Lower task self-initiation was associated with lower math scores.
- Higher feedback was associated with higher reading and math scores.
- Especially for minority and female students, higher articulation, task self-initiation, and feedback were related to higher reading and math scores.
- The more language usage was required, the higher the reading scores, especially for minority and female students.

With regard to personal characteristics, the relationships found are as follows:

- Reading achievement was lower for males than for females.
- Working part-time was associated with lower reading scores, especially for minority students.
- Better attendance was associated with higher math scores especially for males. Better attendance was associated with higher reading scores, but only for males.
- The higher the quality of work rating, the higher the math scores, but only for minority and female students.
- Being a senior was associated with lower math scores, especially for females, and with lower reading scores only for minorities and females.

Independent variables that showed little or no relationship to basic skills achievement in this learning cycle include math skills usage, socioeconomic status, grade level, grade point average, dependability, number of academic and vocational courses taken, education aspiration, and television viewing.

For the Retention Interval

With regard to the relationships between basic skill learning and educational program, the main finding is that vocational nonco-op students did not retain significantly more or less math than general education students did. College preparatory

students, especially whites and males, retained more math than general education students did. White college preparatory students retained more reading skill than general education students did.

With regard to learning environment characteristics, the major finding is that initiation of tasks by someone other than the student is negatively associated with math retention scores, especially for males. With regard to personal characteristics, the main finding is that for whites and for females, a higher number of vocational courses taken is associated with higher math retention scores. The other independent variables showed little or no relationship to basic skill achievement in the retention period.

Conclusions

Overall, the effects were more significant for the learning interval than for the retention interval. The factors studied were, on the whole, not powerful in predicting learning retention. It was clear only that if students scored well at the end of the school year, they tended to score well at the beginning of the next year after the retention period.

For the learning interval, the fundamental question can be asked again: Who learns basic skills best in which setting? A part of the answer suggested by this study is that the students who are in educational programs that continue to demand reading and mathematics learning in a visible way are more successful in acquiring basic skills.

Vocational nonco-op students score lower in math and reading. The findings point to minorities and females being hampered more than others in basic skills achievement just as in the labor market. Where conscious intention and concentration is evident, especially through factors such as task self-initiation, interdependence, and feedback, some positive effects can be noted.

Recommendations

For this sample of students, participation in vocational nonco-op programs depressed both the math and reading scores for the learning interval relative to the performance of general education students. Participation in vocational co-op programs depressed math performance, especially for minority and female students, again relative to the general education students' scores. After the retention interval, the performance of the vocational students was comparable to that of the general

education students. That is, after a period of non-formal schooling, vocational students recovered from their depressed scores, and their performance was similar to the performance of the general education students.

The researchers were aware going into the study that previous research (Weber et al. 1982) had shown that basic skill performance by vocational education students was lower than that of college prep students and lower than or the same as that of general education students. However, the researchers wanted to look at factors within the school environment that might affect basic skill performance and that could be manipulated by teachers. If factors were found that related to increased basic skills achievement, teachers could increase use of those factors. Likewise, if factors were found that related to decreased basic skills achievement, teachers could decrease use of those factors.

The findings seem to indicate that if vocational education feels a responsibility to provide basic skills education for its students, it must examine what is occurring in terms of learning, which activities should have priority in terms of time spent on them, and how to integrate them in the learning itself. Recommendations include:

- Schools should use tests that are compatible with the learning activities in which students are engaged. Students in vocational, general and academic programs are not engaged in the same types of learning experiences. For example, students who are heavily engaged in application rather than theory will not perform well on theoretical tests. The tests should be valid for the content taught. Preliminary results from Loadman, Rinderer, and Wichienwongsa (1986) demonstrated that performance of students in vocational education programs compares favorably with students in traditional college prep and general programs when tests were developed and used that measured basic applied math knowledge and selected science knowledge.

- There is no indication that vocational education is good for everyone and that all students should take it. The negative correlation between reading achievement and having a part-time job seems to suggest that not all students perform well academically when involved in the reality of learning work-related skills.

- There is evidence to support participation in activities directly related to basic skills, e.g., language skills usage, that will increase the basic skill achievement. Therefore, if vocational education wants students to increase basic skills achievement levels, vocational

educators must include in the curriculum those activities related more strongly to mathematics and language skills. In fact, evidence suggests that basic skills must be specifically identified and taught to the students.

With reference to specific variables measured, the following recommendations are made to increase basic skills achievement:

- Feedback - Vocational education must increase the quantity and quality of feedback given students in regard to basic skills. Minorities and females, particularly, seem to benefit from feedback in math learning, while whites, minorities and females benefit from feedback in math retention. Feedback enhances reading retention for minorities.

- Attendance - Students must be in school to enhance basic skills achievement. For both reading and math learning, the effect of attendance was greatest for males.

- Initiator - All students, especially minorities and females, must have opportunities for more self-initiation of tasks. Retention has been increased when students believed they could control their performance by their own efforts (de Charms 1972, 1976).

- Articulation - Students should be involved in more cooperative learning efforts where they have an opportunity to work together.

- Quality of work - Students should be encouraged to produce high-quality work that is accurate and free from error. The more students invest in their work to make it high quality, the greater is the achievement. The effects were greatest in math learning for minorities and females and in math retention for females.

APPENDIX A

SUMMARY OF FINDINGS FROM THE FIRST PROJECT REPORT

The following is a summary of procedures and findings from the first phase of the research project. The information is drawn from Analysis of Students' Basic Skills Performance in Selected Instructional Delivery Systems: Final Report (Crowe et al. 1986).

Procedures

The research effort used an observational method to describe learning environments in terms of an array of basic skills and environmental variables. Trained observers made two rounds of observations in autumn 1984 and spring 1985. The activities reported in observers' notes were then categorized into "task episodes" (Moore 1981), which are defined as segments of time in which the observed individual's attention remains focused on the completion of a particular task. Behaviors and activities within each task episode were coded using the definitions of the observational variables and a coding strategy similar to that devised by Halasz and Behm (1983).

Selected subtests from the Comprehensive Tests of Basic Skills (CTBS) and selected items the National Assessment of Educational Progress (NAEP) were administered at three testing times in order to measure basic skills achievement during the school year (September, January, May). Students participated in interviews that provided demographic information as well as feelings and attitudes toward school and work.

Student Characteristics

Students in the sample were 62.7 percent vocational students, both noncooperative and cooperative; 22.1 percent college preparatory; and 15.2 percent general education. The data analysis showed that while vocational students had not been exposed to areas such as mathematics, English, science, social studies, and foreign languages as much as had college preparatory students, in many cases they had received more exposure to these areas than general education students. Approximately 50 percent of college preparatory students had grades that were Bs or above, compared to 27.7 percent of vocational and 8.7 percent of general education students. College preparatory students also reported spending more time on homework and less time watching television than did general or vocational students. Vocational students spent a proportionally greater amount of time in work situations than did students in other programs.

Summary Findings

Results of the data collection were categorized by student characteristics, skill demands in the learning environments, student perceptions of the learning environments, and relationship between basic skill achievement and educational programs. The data were analyzed in a series of hierarchical regression models. The following conclusions were drawn:

- Regarding the basic skills factors that measured the differential patterns of exposure to and levels of basic skills, it appears that--

  --language arts skill demands (except for speaking) are lower for vocational students than college preparatory students.

  --speaking skill demands are higher for vocational students than for academic students. The vocational co-op work site requires the highest level of speaking skills.

  --vocational students have a higher exposure to, but lower level of, mathematic skill demands than do academic students. Vocational programs, especially at the work site, require a greater exposure to mathematics skills than academic programs do.

- Regarding the attentional factors that assessed students' level of cognitive involvement with data, people, and things, it appears that--

  --data demands are lower for vocational students than for academic students. Although the exposure to data requirements is essentially the same for all students, vocational programs, especially at the work site, require the lowest data skills levels.

  --the level of involvement with people skills is greatest in the vocational nonco-op and co-op work site programs. Vocational nonco-op requires the highest frequency of involvement with people, and the vocational co-op work site requires the highest level of people skills.

  --demands for involvement with things are higher for vocational students than for academic students. Vocational programs, especially the work site component, had greater exposure to and level of involvement with things than did academic programs.

- Regarding environmental factors that assessed the characteristics of the settings related to the enhancement of basic skills, it appears that--

--the learning environments of vocational co-op work site students are far more complex than those of students in vocational or academic classrooms. Co-op students at the work site performed significantly more tasks necessary for others to carry out their own work than did classroom-based students. Co-op students in class and at the work site performed more self-initiated tasks than did college preparatory and general studies students, whose tasks were more teacher directed. Co-op students at the work site were required to carry out the widest variety of tasks and cope with the most interruptions in coordinating tasks but encountered the lowest number of simultaneous tasks.

--vocational students had less autonomy, self-direction, and feedback in carrying out their tasks than did academic students. Vocational programs, especially in the classroom, provided significantly lower autonomy in task execution than did academic programs. Vocational programs, especially at the work site, engaged student in more highly prescribed tasks than academic programs did. The vocational co-op classroom component provided less feedback than college preparatory (the highest), general studies, and the vocational work site component.

The findings regarding students' perceptions of their learning environments are as follows:

- Vocational co-op students perceived their classrooms as being lower on affiliation than did college preparatory students.

- College preparatory and vocational nonco-op students perceived their classrooms as being higher on teacher support than did vocational co-op students.

- College preparatory students perceived their classrooms as being higher on order and organization than did vocational co-op students.

- Vocational nonco-op students perceived their classrooms as being higher on teacher control than did college preparatory students.

- Vocational co-op students perceived their work environments as being higher on involvement than did students who held part-time jobs not related to school.

An examination of the relationship between students' basic skill achievement (from September to January, the fall testing period; and from January to May, the winter testing period) and participation in educational programs has led to the following general findings:

- Overall for students as a group (across settings), both mathematics and reading achievement increased slightly from the fall to winter testing and then decreased from the winter to spring testing.

- No consistent relationships exist between the selected demographic characteristics and basic skills achievement.

- Grade level is negatively related to the changes in both mathematics and reading achievement observed from winter to spring.

- The most consistent relationship existing between the other student characteristics and basic skills achievement involves the students' current marks in school.

- The school in which students are enrolled is very critical to basic skills achievement.

- Consistent relationships exist between programs and basic skills achievement.

- The effect of classes to which students are assigned, like that noted earlier for schools, is very important to basic skills achievement.

The findings of this study seem to indicate that all educational programs have something to learn from each other about providing basic skills to students. The authors' perspection is that there are multiple pathways for students to acquire basic skills and that students should be encouraged to take advantage of alternative ways to learn basic skills.

Recommendations for vocational programs are as follows:

- Increase both the exposure to and the level of reading skills required for vocational students.

- Increase the demand for the level of mathematics skills that vocational students use in completing tasks.

- Increase the vocational students' involvement and intensity with activities requiring the use of data.

- Increase vocational students' opportunities for autonomy, self-direction, and feedback.

- Create a more caring and supportive learning environment to help students perceive vocational education classes more positively.

Recommendations for academic programs are as follows:

- Increase both the exposure to and the level of speaking skills.
- Increase the opportunities for students to use manipulative skills.
- Diversify these environmental factors in the classroom:

  --variety
  --self-initiation
  --coping with changes in the environment
  --significance of the task for the student

REFERENCES

Alexander, Karl L.; Cook, Martha; and McDill, Edward. "Curriculum Tracking and Educational Stratification: Some Further Evidence." American Sociological Review 43 (February 1978): 47-66.

Alexander, Karl L., and McDill, Edward L. "Selection and Allocation Within Schools: Some Causes and Consequences of Curriculum Placement." American Sociological Review 41 (December 1976): 963-80.

Amidon, E. J., and Hough, J. Interaction Analysis: Theory, Research, and Application. Reading, MA: Addison-Wesley, 1967.

Anderson, H. H., and Brewer H. M. "Studies of Teacher's Classroom Personalities, 1: Dominative and Socially Integrative Behavior of Kindergarten Teachers." In Applied Psychology Monographs of the American Association for Applied Psychology no. 6, edited by H. S. Conrad. Washington, DC: American Association for Applied Psychology, 1945.

Anderson H. H., and Brewer, J. E. "Studies of Teachers' Classroom Personalities, 2: Effects of Teachers' Dominative and Integrative Contacts on Children's Classroom Behavior." In Applied Psychology Monographs of the American Association for Applied Psychology no. 8, edited by H. S. Conrad. Washington, DC: American Association for Applied Psychology, 1946.

Anderson, L. M. "Classroom Management: Making Time to Learn Basic Skills." In Basic Skills: Issues and Choices, Vol. 1, edited by L. Reed and S. Word, pp. 33-40. St Louis: CEMREL, 1982.

Berliner, David C. "The Half-Full Glass: A Review of Research on Teaching." In Using What We Know About Teaching, edited by Philip L. Hosford. Alexandria, VA: Association for Supervision and Curriculum Development, 1984.

Bower, G. H., and Hilgard, E. R. Theories of Learning. Englewood Cliffs, NJ: Prentice-Hall, 1981.

Brookover, W.; Beady, C.; Flood, P.; Schweitzer, J.; and Wisenbaker, J. School Social Systems and Student Achievement: Schools Can Make a Difference. New York: Praeger, 1979.

Brookover, Wilbur; Beamer, Laurence; Efthim, Helen; Hathaway, Douglas; Lezotte, Lawrence; Miller, Stephen; Passalacqua, Joseph; and Tornatzky, Louis. Creating Effective Schools: An Inservice Program for Enhancing School Learning Climate and Achievement. Holmes Beach, FL: Learning Publications, 1982.

Brophy, J. E. "Teacher Behavior and Its Effects." Journal of Educational Psychology 71 (1979): 733-50.

Brophy, J. E., and Putnam, J. "Classroom Management in the Elementary Grades: A Literature Review." In Classroom Management. Seventy-Eighth Yearbook of the National Society for the Study of Education, edited by D. Duke, pp. 65-87. Chicago: University of Chicago Press, 1979.

Castenell, Louis A. "Achievement Motivation: An Investigation of Adolescents' Achievement Patterns." American Educational Research Journal 20, no. 4 (Winter 1983): 503-10.

Chavez, R. C. "The Use of High-Influence Measures to Study Classroom Climates: A Review." Review of Educational Research 54 (1984): 237-61.

Corman, L. Basic Skills Proficiencies of Secondary Vocational Students. Washington, DC: National Institute of Education, 1980.

Craik, F. I. M., and Lockhart, R. S. "Levels of Processing: A Framework for Memory Research." Journal of Verbal Learning and Verbal Behavior 11, no. 6 (1972): 671-84.

Crowe, Michael R.; Hettinger, Lawrence J.; Weber, James; and Johnson, Judith. Analysis of Students' Basic Skills Performance in Selected Instructional Delivery Systems: Final Report. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1986.

de Charms, R. Enhancing Motivation: A Change in the Classroom. New York: Irvington, 1976.

_____. "Personal Causation Training in the Schools." Journal of Applied Psychology 2 (1972): 95-113.

Deutsch, M. "A Theory of Cooperation and Competition." Human Relations no. 2 (1949): 129-51.

Dunkin, M., and Biddle, B. The Study of Teaching. New York: Holt, Rinehart and Winston, 1974.

Ethington, Corinna A., and Wolfle, Lee M. "A Structural Model of Mathematics Achievement for Men and Women." American Educational Research Journal 23, no. 1 (Spring 1986): 65-75.

Finch, Michael D., and Mortimer, Jeylan T. "Adolescent Work Hours and the Process of Achievement." Research in Sociology of Education and Socialization 5 (1985): 171-96.

Flanders, N. Analyzing Teacher Behavior. Reading, MA: Addison-Wesley, 1970.

Frederiksen, Norman. "Implications of Cognitive Theory for Instruction in Problem Solving." Review of Educational Research 54, no. 3 (Fall 1984): 363-407.

Gamoran, Adam. "The Stratification of High School Learning Opportunities." Paper presented at the annual meeting of the American Education Research Association, San Francisco, 1986.

Gates, A. I. "Sex Difference in Reading Ability." Elementary School Journal 61 (1961): 431-34.

Goodlad, J. A. "Can Our Schools Get Better?" Phi Delta Kappan 60 (1979): 342-46.

Greenberger, Ellen. "Children, Families and Work." In Children, Mental Health, and Law, edited by N. D. Reppucci, L. A. Weithorn, E. P. Mulvey, and J. Monahan. Beverly Hills: Sage, 1983.

Greenberger, Ellen, and Steinberg, Lawrence D. Part-Time Employment by In-School Youth. An Assessment of Costs and Benefits. Irvine: California University, 1980. (ERIC Document Reproduction Service No. ED 227 334)

Halasz, Ida M., and Behm, Karen S. Time on Task in Selected Education Classes. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.

Henry, J. F., and Raymond, S. U. Basic Skills in the U.S. Work Force: The Contrasting Perceptions by Business, Labor, and Public Education. New York: Center for Public Resources, 1983.

Hogrebe, Mark C.; Nist, Sherrie L.; and Newman, Isadore. "Are There Gender Differences in Reading Achievement? An Investigation Using the High School and Beyond Data." Journal of Educational Psychology 77, no. 6 (1985): 716-24.

Hotchkiss, Lawrence. High School Tracking and Stratification. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1986.

"How Business Is Joining the Fight against Functional Illiteracy." Business Week, 16 April 1984, pp. 94-98.

Johnson, D. W., and Johnson, R. T. "The Internal Dynamics of Cooperative Learning Groups." In Learning to Cooperate, Cooperating to Learn, edited by Robert Slavin, Shlomo Sharan, Spencer Kagan, Rachel Hertz-Lazarowitz, Clark Webb, and Richard Schmuck. New York: Plenum Press, 1985.

Laster, Janet F. Toward Excellence in Vocational Education: Using Cognitive Psychology in Curriculum Planning. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1985.

Levini, Daniel U., and Ornstein, Allan C. "Sex Differences in Ability and Achievement." Journal of Research and Development in Education 16, no. 2 (Winter 1983): 66-72.

Lewin, K.; Lippit, R.; and White, R. K. "Patterns of Aggressive Behavior in Experimentally Created Social Climates." Journal of Social Psychology 10 (1939): 271-99.

Lewis, Morgan V.; Gardner, John A.; and Seitz, Patricia. High School Experience and its Effects. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.

Lezotte, Lawrence W.; Hathaway, Douglas V.; Miller, Stephen K; Passalacqua, Joseph; and Brookover, Wilbur B. School Learning Climate and Student Achievement. Edited by Geraldine S. Lake. Tallahassee: Site Specific Technical Assistance for Teacher Corps, Florida State University, 1980.

Lippit, R. "An Analysis of Group Reaction to Three Types of Experimentally Created Social Climates." Ph.D. diss., University of Iowa, 1940.

Loadman, William E.; Rinderer, Ray E.; and Wichienwongsa, Wannaporn. Technical Report Comparison of Students Enrolled in Vocational Education on Common Indicators of Science and Mathematics. Columbus: The Ohio State University, 1986.

Magnusson, D. "Problems in Environmental Analyses--An Introduction." In Toward a Psychology of Situations: An Interactional Perspective, edited by D. Magnusson. Hillsdale, NJ: Lawrence Erlbaum, 1981a.

_____. "Wanted: A Psychology of Situations." in Toward a Psychology of Situations: An Interactional Perspective, edited by D. Magnusson, Hillsdale, NJ: Lawrence Erlbaum, 1981b.

Marshall, H. H., and Weinstein, R. S. Classroom Dimensions Observation System: Manual. Berkeley: Department of Psychology, University of California, 1982.

Marshall, Hermine H., and Weinstein, Rhona S. "Classroom Factors Affecting Students' Self-Evaluations: An Interactional Model." Review of Educational Research 54, no. 3 (Fall 1984): 301-25.

Medley, D. M., and Mitzel, H. E. "Measuring Classroom Behavior by Systematic Observation." In Handbook of Research on Teaching, edited by N. L. Gage. Chicago: Rand McNally, 1963.

Moore, D. T. "Discovering the Pedagogy of Experience." Harvard Educational Review 51, no. 2 (1981): 286-300.

National Commission on Excellence in Eduction. A Nation at Risk: The Imperative for Educational Reform. Washington, DC: Government Printing Office, 1983.

Oakes, Jeannie. "The Reproduction of Inequality: The Content of Secondary School Tracking." The Urban Review 14 (1982): 107-20.

Ouzts, Dan T. "Teacher Expectation: Implications for Achievement." Reading Horizons 26, no. 2 (Winter 1986): 133-39.

Pepitone, Emmy A. "Children in Cooperation and Learning." In Learning to Cooperate, Cooperating to Learn, edited by Robert Slavin, Shalomo Sharan, Spencer Kagan, Rachel Hertz-Lazarowitz, Clark Webb, and Richard Schmuck. New York: Plenum Press, 1985.

Pottebaum, S. M.; Keith, T. Z.; and Ehly, S. W. "Is There A Causal Relation Between Self-Concept and Academic Achievement?" Journal of Educational Research, 79, no. 3 (1986): 140-44.

Rosenbaum, James E. Making Inequality: The Hidden Curriculum of High School Tracking. New York: John Wiley & Sons, 1976.

Rosenshine, Barak V. "Effective Teaching in Industrial Education and Training." Journal of Industrial Teacher Education 23, no. 2 (Winter 1986): 5-19.

Rosenshine, B , and Furst, N. "Research on Teacher Performance Criteria." In Research in Teacher Education: A Symposium, edited by B. Othanel Smith. Englewood Cliffs, NJ: Prentice-Hall, 1971.

Schneider, W., and Fisk, A. D. "Concurrent Automatic and Controlled Visual Search: Can Processing Occur Without Resource Cost?" Journal of Experimental Psychology: Learning, Memory and Cognition 8 (1982): 261-78.

Schneider, W., and Shiffrin, R. M. "Controlled and Automatic Human Information Processing: I. Detection, Search and Attention." Psychological Review 84 (January 1977): 1-66. (ERIC No. EJ 159 781)

Schroder, Harold M.; Karlins, Marvin; and Phares, Jacqueline O. Education for Freedom. New York: John Wiley and Sons, 1973.

Shiffrin, R. M., and Schneider, W. "Controlled and Automatic Human Information Processing: II. Perceptual Learning, Automatic Attending, and a General Theory." Psychological Review 84 (March 1977): 127-90. (ERIC No. EJ 161 631)

Silvernail, D. L. Teaching Styles as Related to Student Achievement. Washington, DC: National Education Association, 1979.

Slavin, R. E. "Introduction to Cooperative Learning Research." In Learning to Cooperate, Cooperating to Learn, edited by Robert Slavin, Shlomo Sharan, Spencer Kagan, Rachel Hertz-Lazarowitz, Clark Webb and Richard Schmuck. New York: Plenum Press, 1985.

Slavin, R. E. "When does Cooperative Learning Increase Student Achievement?" Psychology Bulletin 94 (1983): 429-45.

Squires, David A.; Huitt, William G.; Segars, John K. Effective Schools and Classrooms: A Research-Based Perspective. Alexandria, VA: Association for Supervision and Curriculum Development, 1983.

Steinberg, Laurence D.; Greenberger, Ellen; Garduque, Laurie; and McAuliffe, Sharon. "High School Students in the Labor Force: Some Costs and Benefits to Schooling and Learning." Educational Evaluation and Policy Analysis 4, no. 3 (1982): 363-72.

Sticht, T. G. Literacy and Vocational Competence. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

Sticht, Thomas G., and Mikulecky, Larry. Job-Related Basic Skills: Cases and Conclusions. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

Thomas, D. S. Some New Techniques for Studying Social Behavior. New York: Bureau of Publications, Teachers College, Columbia University, 1929.

U.S. Department of Education, National Center for Education Statistics. The Condition of Education, 1983 ed., edited by Valena White Plisko. Washington, DC: Government Printing Office.

U.S. Department of Health, Education, and Welfare, Public Health Service. Intellectual Development and School Achievement of Youths 12-17 Years: Demographic and Socioeconomic Factors. Washington, DC: Government Printing Office, 1976.

Ward, Barbara; Mead, Nancy A.; and Searls, Donald T. The Relationship of Students' Academic Achievement to Television Watching, Leisure Time Reading and Homework. Denver: National Assessment of Educational Progress, Education Commission of the States, 1983. (ERIC Document Reproduction Service No. ED 236 249)

Weber, James M.; Silvani-Lacey, Cindy; Williams, E. Jane; Winkfield, Patricia W.; Manning, Kevin J.; Okeafor, Karen; and Denniston, Denie. A Quantitative Study of Basic Skills and Vocational Education. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Weinstein, R. S. "Reading Group Membership in First Grade: Teacher Behavior and Pupil Experience Over Time." Journal of Educational Psychology 68 (1976): 103-16.

Weinstein, R. S.; Marshall, H. H.; Brattesani, K. A.; and Middlestadt, S. E. "Student Perceptions of Differential Teacher Treatment in Open and Traditional Classrooms." Journal of Educational Psychology 74, no. 5 (1982): 678-92.

Withall, J., and Lewis, W. W. "Social Interaction in the Class." In Handbook of Research on Teaching, edited by N. L. Gage. Chicago: Rand McNally, 1963.