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ABSTRACT

A wide range of evidence was gathered to determine the interrelationship between participation in secondary vocational education, basic skills (reading, writing, and arithmetic), attainment, and gainful employment. Sources of data included research on basic skills needed in jobs, two national longitudinal data sets, previous studies, and test scores for a wide variety of predominantly white students over several years. Findings were that (1) basic skills are important for a wide range of occupations, but it is impossible to determine the exact level of basic skills that are functionally required for specific occupations; (2) the basic skills attainments of those participating in general and in vocational secondary programs appear to be similar; (3) graduation from secondary vocational education programs as opposed to general high school programs does appear, in at least some cases, to be associated with employment advantages; and (4) basic skills attainments as reflected in standardized test scores do not appear to be strongly related to employment success, once years of schooling are controlled for as a variable. The study concluded that secondary vocational education can yield employment advantages without giving clearcut advantages to its graduates in terms of basic skills attainment. (KC)

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SECONDARY VOCATIONAL EDUCATION,

BASIC SKILLS, AND EMPLOYMENT

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I. BACKGROUND, PURPOSE AND SCOPE

Background. Recently there has been much concern for improvement of basic skills instruction in our nation's schools. In 1978, a new Title II was added to the Elementary and Secondary Education Act of 1965, to promote establishment of programs of basic skills improvement so that "all children are able to master the basic skills of reading, mathematics and effective communication both written and oral" (Sections 201, 221). In 1979, the National Commission for Employment Policy, in its fifth annual report, wrote:

> Many youth, especially the youngest and those from economically-disadvantaged or minority backgrounds, are not ready for the labor market and cannot compete successfully with adults or other youth for available jobs. . . . An individual who has not mastered the three Rs and life coping skills is shut out of a large and growing share of the jobs offered in a modern, technologically-sophisticated and paper-oriented society. As unskilled laborer jobs continue to decline as a share of total job opportunities, even entry-level jobs will become more difficult to find for people who cannot at least read. Advancement beyond the entry level will be less likely for such people. (pp. 96-97)

In the same year the Task Force on Education and Employment of the National Academy of Education (1979) stressed that an all-out effort is needed in Federal programs related to education, work, and service to stimulate more action in "developing basic skills" (p. 21).

Given such concern it is not surprising that basic skills attainment has been receiving substantial attention as a goal of vocational education. Barlow (1971, p. 30) for example, pointed out the special problems that students "who cannot read or write well, who have failed to achieve occupationally acceptable communication skills including mathematics achievement" pose to vocational education programs. Bottoms (1979, p. 8) observed that research has shown a close association of basic skills (including verbal and mathematical skills) with employability skills. Thurow (1979) argued that literacy skills are one of the primary criteria used by employers in making employment and promotion decisions. As a result, he argues that literacy should be the number one goal of vocational education today. His view is that in a competitive job market with graduates from other curricula, the vocational education curriculum graduates will have to persuade employers that "they have literacy standards that are as high, if not higher, than the students who come from the standard educational paths" (p. 327).

Around the same time, the U.S. Department of Education's Office of Vocational and Adult Education (formerly the Bureau of Occupational and Adult Education) noted that "Basic educational skills are essential to all persons, and vocational education must complement basic skill remedial programs if persons are to succeed in vocational education programs . . . . [A]cademic and vocational programs should complement and further one another in producing persons who are prepared to function responsibly in a working world" (Federal Register, June 13, 1979, p. 33961, cited in Corman, 1980, p.4).

Despite the recent interest in basic skills instruction in vocational education, it is worth noting that concern for basic skills attainment as a goal for vocational education has a long history in America. Colonial legislation emphasized dual responsibilities for the master: the training in an occupation for useful employment and the teaching of a fundamental literacy (Lannie, 1971). The importance of literacy skills for employment emerged as a specific concern regarding vocational education in the 1960s. One of the needs of vocational education programs addressed by the Panel of Consultants (1963, p. 221) was improvement in the basic skills of vocational education students. While previous to 1963, Federal funds were restricted to instruction in vocational courses, the 1963 Act expanded the definition of vocational education to include "instruction related to the occupation for which the student is being trained or necessary for him to benefit from such training" (Section 8). The Education Amendments of 1968 authorized the provision of "remedial or related academic" instruction as part of federally-funded vocational education.

Purpose. In an earlier study (Woods & Haney, 1981), we reported on outcomes associated with participation in vocational education at both the secondary and postsecondary levels. Because the main goal of vocational education since its inception has been to prepare participants for gainful employment, we focused especially on a variety of indicators of gainful employment. In this report, we turn to focus on the relationship between vocational education and what is loosely called basic skills attainment. In particular we seek to compare the basic skills attainments of secondary vocational students with those of secondary general program students.* However, before focusing on this general question, in Chapter II we first review evidence bearing on the skill requirements of occupations into which secondary vocational graduates might enter. Then in Chapters III and IV, we examine the data sets in order to compare basic skills attainment of secondary vocational with those of secondary general students. Having done so, we turn in Chapter V to provide a summary of our previous research on employment outcomes associated with participation in secondary vocational programs, and to consider selected evidence on the relationship between basic skills attainment at the secondary level, and subsequent employment outcomes. Chapter VI provides a general summary of the entire report.

* For the explanation of why we think it more appropriate to compare secondary vocational students with secondary general students, rather than with academic or college preparatory program students, see Woods & Haney, 1981.

Scope. Before launching into the substance of these issues, three key aspects of this report should be explained.

First, this study focuses exclusively on vocational education at the secondary level. Vocational education programs and students at the postsecondary level are not considered here for several reasons. One is that the vast majority of vocational education students in the nation are enrolled at the secondary rather than the postsecondary level. According to the latest available data, approximately two-thirds of the 20 million enrollments in vocational education in 1978 were at the secondary level (NCES, 1980, p. 561).* A second reason is that basic skills attainment is typically considered to be a goal of elementary and secondary levels of our nation's educational system. In the past, it has commonly been assumed that students who graduate from high school have mastered basic skills. In recent years increasing concern has been expressed over whether all students graduating from high school have in fact mastered basic skills of reading, writing, and mathematics. Such concern was one of the motivating forces behind the minimum competency testing movement in the late 1970s, and thus, even though basic skills instruction is surely a more widely recognized responsibility of elementary and secondary education, examining the basic skills attainments of postsecondary vocational education would be of interest. However, our third reason for focusing on the secondary level is that there is simply no available evidence on the issue of basic skills attainments of postsecondary vocational students that we know of. Indeed, as we pointed out in our earlier report, there is relatively little evidence available on outcomes of postsecondary vocational education in general.

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* It should be noted that the data cited refer to enrollments in vocational education programs overall. If attention is restricted to occupationally specific vocational education programs, in 1978-79 we find that 3.0 million were enrolled in grades 11-12, 1.9 million at the postsecondary level, and another 2.8 million in adult vocational education programs of an occupationally specific nature (NCES, 1980, p. 582).

Second, in this report we use the term basic skills to refer to the traditional 3R's of schooling, namely reading, writing and arithmetic or mathematics. As indicated in some of the passages quoted above, "basic skills" are sometimes conceived of more broadly, for example, to include oral communication, and so-called life-coping skills. Without gainsaying the importance of skills beyond reading, writing and mathematics, we focus on these three broad types of skills for two reasons. First, these are the three types of skills which typically are considered to be the basic skills of schooling. For example, of the 31 states which instituted minimum competency testing programs in the 1970s, 30 set out competencies in reading and mathematics, 21 included competency in writing, but less than 20 included competencies in other skill areas (Gorth, et al., 1979, summarized in Haney et al., 1980).

Third, even though in Chapter II of this report we focus only on the skills of reading, writing and math, we should point out that the measures available with which to assess such skills are nevertheless limited in a number of important respects. In Chapter III, we will discuss the measures available in national longitudinal data sets, upon which we relied in conducting reanalyses concerning basic skills acquisition. But before we do so, let us turn in Chapter II to review what is known about the skill requirements of occupations. Chapter IV provides an overall summary and conclusions.

II. BASIC SKILL REQUIREMENTS OF OCCUPATIONS

What skills are needed for jobs? This question is of obvious importance to vocational education in general, for in order to prepare individuals for gainful employment above unskilled levels, vocational education must seek to impart the skills that are required for jobs. More specifically relevant to the purpose of this report, we would like to know what kinds of skills are required for the sort of occupations for which vocational education programs aim at preparing students to enter. The problem with such an inquiry is that secondary vocational education programs aim at preparing students for a wide range of occupations. Vocational education program offerings are traditionally described in terms of nine occupational areas:

- Agriculture
- Distributive
- Health
- Consumer and homemaking
- Occupational home economics
- Industrial arts
- Office occupations
- Technical
- Trade and industrial

Yet the NCES publication The Condition of Vocational Education (1980) lists nearly 100 occupationally specific instructional programs in which secondary vocational education students were enrolled in 1978-79.

Another problem in ascertaining the basic skill requirements of occupations for which vocational education seeks to prepare students is that widely varied approaches have been used in the past to identify basic skills and to assess them. As mentioned above, for the purposes of this paper we are restricting the definition of basic skills, mainly to those of reading, writing and math. Yet even for these three widely acknowledged "basic skills," a wide variety of methods have been used to assess what skill levels are required for different occupations.

Despite these problems, we shall briefly review previous research on the question of what skills are required for different kinds of occupations. Our review is divided into two parts. First we review, the Bureau of Labors' Supplement to the Dictionary of Occupational Titles. This supplement provices estimates of physical demands, working conditions and training requirements for each of more than 10,000 occupational titles listed in the Dictionary and is probably the most widely used source of information on the skill requirements of jobs. Second we review a variety of smaller scale research studies on the skill and literary requirements of jobs since around 1970. It should be noted that this review is not an altogether comprehensive review of literature bearing on these topics. Available time and resources did not allow us to review as much of the literature bearing on the questions addressed in this chapter as ideally would have been desireable.

Supplements to the Dictionary of Occupational Titles.

In 1977, the Bureau of Labor published the fourth edition of the Dictionary of Occupational Titles. The two volumes of this Dictionary describe nearly 22,000 occupations. Each is coded using a six-digit classification (e.g. 201.368) system to indicate the kind and level of work performed. The first digit indicates one of nine broad occupational categories. The next two digits refer to more specific occupational categories and the fourth, fifth and sixth digits indicate functional occupational relationships with data, people and things. This classification scheme has been widely used in analyzing the structure of the American labor market, but is in and of itself not directly useful for analyzing the skill requirements of occupations.

For such an analysis, we must turn to the 1966 Supplement, Selected Characteristics of Occupations, (Physical Demands, Working Conditions, Training Time). This document provides estimates of physical demands, working conditions and education and training requirements for each of approximately 14,000 occupational titles listed in volume II of the 1965 edition of the Dictionary. As Fine (1968) points out, anyone using these data on "education and training requirements" should be aware of the distinction between three alternative definitions of the term "educational and training requirements":

> Functional or Performance Requirements: These are the requirements determined by objective job analysis as necessary and sufficient to achieve average performance in the specific tasks performed in relation to the things, the data, or the people involved in those tasks. For example, they do not include the requirements for promotion to another job. The estimated requirements for the apprentice carpenter are for the man performing apprentice duties; they are not the duties of the journeyman. This approach was used in arriving at the educational and training requirements in the present supplement to the DOT.
>
> Employer or Hiring Requirements. These requirements reflect conditions in the labor market and may or may not be related to the functional requirements described above. Thus, for example, in a loose labor market such as existed during the Depression, the educational requirements for a salesgirl often was "some college" or even, in some instances, "college graduation." Today, in many factories, the requirement for an ordinary assembly or fabricating job is "high school graduation," largely because this amount of education is possessed by a great many workers who are available in the labor market. It is not necessarily related to the performance requirements of the job tasks. Indeed, tasks for which high school graduation may now be required are in many instances being performed by workers with much less education and training who were hired in an earlier period.
>
> Educational Attainment: The median educational attainment of workers obtained from a sample census frequently is presented in tables for various occupational groups. This attainment is then interpreted as being the same as "requirements"--an interpretation which is, or course, incorrect and which can be extremely confusing.
>
> (Fine, 1968, pp. 365-6)

As Fine implicitly suggests the distinction between these alternative definitions of education and training requirements can be very important. Just because individuals engaged in certain occupations at a particular point in time possess certain skills or levels of education does not necessarily mean that such skills or education are <u>functionally</u> required for the jobs they hold. Distributions of skills and education, quite apart from functional requirements may be affected by hiring requirements, the laws of supply and demand, and a variety of other factors.

How then did the Department of Labor go about estimating the functional skill requirements of occupations? Briefly it was as follows. First skill requirements were separated into two broad categories: general educational development (GED), and specific vocational preparation (SVP). Since we are concerned here with basic skills rather than specific vocational skills, we will describe only the former and not the latter.

The GED requirements of occupations were considered in terms of three types of skills, namely: reasoning, mathematics, and language. Skill requirements in each of these three areas were estimated by trained raters using task statements of the occupational definitions provided in the <u>Dictionary of Occupational Titles</u>. Using a scale from 1 to 5 or 6, raters were asked to assess what reasoning, mathematics and/or language levels are implicit in workers' ability to carry out the tasks defining each occupation. Every occupation was rated for each skill by two raters, with discrepancies in ratings resolved by a third rater. The rating procedure was validated in a study of around 250 jobs in the clock and watch industry. In the validation study, job analysts in the field made independent estimates of skill requirements, and these were compared with the ratings made simply on the basis of job task definitions. According to Fine (1968) the resulting Spearman correlations for the GED skills averaged 0.84.

Such GED ratings prepared in conjunction with both the third (1965) and fourth (1977) editions of the Dictionary of Occupational Titles are the source of information of skill requirements of jobs most widely used by economists and other researchers (e.g. Rumberger, 1979, 1981; Scoville, 1969; Eckaus, 1964). Rumberger (1979) for example, from his analysis of the distribution of jobs in the United States and the skill requirements of jobs has suggested that "the general skill requirements of jobs have changed little over the past decade and a half -- a period of rapid growth and technological development" (pp. 17-18).* Comparing this finding with the markedly increased levels of educational attainment of young Americans over the same period, Rumberger, like several others, has recently expressed concern over the problem of overeducation, which he defines as the condition in which "workers possessing more education, and hence more skills, than their jobs require are overeducated" (Rumberger, 1981, p. 8). What should be pointed out about such a definition is that it defines the problem strictly in terms of estimated functional skill requirements of occupations. From other points of view, for example education for citizenship or for self-fulfillment, the "problem" of overeducation may be not a problem at all. Nevertheless, for present purposes of analyzing the relationship between basic skills and vocational education, Rumberger's analysis based on DOT data, clearly suggests

* It should be noted, however, that as Rumberger points out this finding may result partially from "revisions in the estimates of skill requirements . . . contained in the 4th edition of DOT" (p.17).

that when it comes to getting jobs, the major constraint for vocational education graduates may not be whether they possess functionally required basic or general educational skills, but instead how their skills compare with those of other potential workers. This is, of course, precisely the point made by Thurow (1979), cited in the introduction, namely that in a competitive job market, with more workers available than jobs for them, the key issue is how the literacy standards of vocational graduates compare with those of other curriculum programs.

Other Research on Skill Requirements of Jobs

Though the DOT has been quite widely used in analyses of skill requirements of occupations, it also has been criticized in terms of its utility for such purposes. Sticht (1975), for example, has suggested that the DOT ratings provide "only the coarsest differentiation" of literacy requirements of jobs (p.90) and that in any case the procedures for determining skill requirements using the DOT ratings were not objective. In light of such criticisms, in this section, we review a variety of research since 1970 on the basic skills requirements of occupations. Our review draws heavily on a previous review of relevant literature by Corman (1980) but incorporates some literature not available at the time of this previous review.

Since around 1970, Sticht and his colleagues at the Human Resources Research Organization have conducted a variety of inquiries into the literacy requirements of jobs. In an initial study, Sticht et al. (1972) investigated the relationship between scores on standardized reading tests and indicators of job performance. Estimates of the readibility (indicating the difficulty of prose in terms of characteristics such as vocabulary and sentence length) were performed on written materials used in jobs such as that of repairman and cook. They concluded that the difficulty of written material exceeded the test performance of low-aptitude men by as much as eight grade levels. Sticht (1975) and colleagues also developed a Job Reading Task Test for the U. S. Army as a means of estimating the general reading level requirement to do military jobs. They used this instrument and data on new recruits to estimate reading levels required for personnel in different jobs. In a subsequent study, Sticht (1978) reported on a reading task analysis for individuals holding a variety of Navy jobs. He concluded that a majority of job-related reading tasks entail more innate cognitive demands than ones susceptible to improvement through typical reading training and instruction. Nevertheless Sticht concluded that reading ability was strongly related to performance in the jobs studied.

In another study, the Canada Employment and Immigration Commission (1977) investigated the so-called generic skills required in some 70 occupations. The term "generic skills" was used to refer to ones "which are actively used in work performance [and] which are transferable from one job or occupation to another and which are needed for promotion to supervisory status" (p.1). The skills so defined as generic were:

Communications (reading, writing, listening and speaking)
Mathematics (arithmetic, geometric figures, intermediate mathematics)
Science (physics, biology, chemistry, general)
Reasoning (estimating, sort/classify, obtain job-related information, work tests)

To estimate skills required in each of these areas, both workers and supervisors in different occupations were surveyed.* It was reported

* The Commission report does not make it clear exactly what questions were posed in the survey, but apparently respondents were asked to rate skill needs in terms of whether skill needs were required by "nil, few, many or most/all workers" in each occupation.

that "the coefficient of correlation between workers and supervisors' data exceeded 0.95" (p. 3). Such a strong association between workers' and supervisors' ratings seems to us almost too high to believe. However, it is unclear what to make of the correlation because the exact basis on which it was calculated is not explained. Nevertheless, the Commission report goes on to report the various skill needs for each of ten occupational areas, indicating for example that reading, writing, listening, conversing and arithmetic skills are needed in most/all clerical occupations.

More recently Mikulecky and Diehl (1979, 1980, and Mikulecky, 1980) conducted a study of the literacy demands encountered in a range of occupations. A survey was carried out in a range of businesses and industries in and around Bloomington, Indiana. In the selected workplaces, individuals were randomly selected within occupational categories so as to obtain a sample roughly comparable to the distribution of workers in the U.S. across nine broad occupational categories (the ones represented by the first digit in the DOT occupational code). Altogether 107 workers were included in the survey. Each subject was interviewed at his or her workplace in order to determine scope of literacy demands, depth of literacy demands, amount of time spent per day on the job reading, plus a variety of other job and personal characteristics. Also analyses were made of the difficulty of materials read on the job using the FORCAST readibility formula. The following findings were noted:

> Almost all [i.e. nearly 99%] subjects report some reading and/or writing tasks as part of their jobs . . . .
> Subjects report an average of 113 minutes a day spent job-reading.
> Literary tasks done on jobs tend to be highly repetitive and an integrated part of other job tasks. . . .
> Reading tasks tend to be viewed as "important, but not vital" to completion of job tasks . . . .
> Reading tasks tend to be of a reading-to-do type significantly more often than a reading-to-learn or reading-to-assess type . . . .

> Writing tasks on the job tend to also be brief in nature, most often involving filling out prepared forms or completing short memos or papers . . . .
> [T]he difficulty of job [reading] materials tends to not vary significantly among occupational levels . . . .
> (Mikulecky and Diehl, 1979, pp. 59-63)

The latter finding, it was suggested may be an artifact of the readability formula employed. Also it was noted that "reading at work and reading in school settings may be quite different in terms of extralinguistic cues available, cognitive demands and uses of information gained" (p. 62) and that "measures of literacy <u>demands</u> are highly predictive of occupational success levels" (p. 62, emphasis added). In addition to such overall results, Mikulecky and Diehl present more detailed data on the indices of scope and depth of literacy demands, reading difficulty of job materials, amount of time reading on the job per day and a variety of "strategies used to job literacy situations," by respondents' income levels, job status and occupational categories in appendix tables.

More recently, Mikulecky (1980) has written a wide-ranging paper on the relationships between literacy and youth employment. He suggests, among other things, that:

(1) Workers perform better on job reading tasks than they do on general reading tasks.
(2) Employers typically do not require that youths entering the job market have high levels of literacy, but instead generally seem to ask only that they "know enough to be trainable." An exception to this general pattern appears to be the office/clerical area, which surveys have shown to have "clear-cut job literacy testing" (p. iii).
(3) There is little relationship between "school-type" learning and literacy demands on the job (p. viii).
(4) Little is known about the relationship between job literacy and actual job performance (p. ix).

At Purdue University Moe et al. (1979) conducted a study of the literacy (reading, writing, listening, speaking and mathematics) requirements of ten different occupations. Reading requirements were assessed by applying readability formulae (specifically the Dale-Chall formula and the Fry readability graph) to samples of reading materials used in each occupation. Recorded samples of oral language were used as the basis for assessing speaking and listening requirements. Writing samples were obtained in order to assess job writing demands, and mathematics demands were determined "through surveys of materials from the job sites." Though the exact procedures used to derive skill requirements using these methods are not described, Moe et al. (1979) did prepare ten booklets describing the skill requirements of ten occupations (such as account clerk, auto mechanic, and secretary) both on the job and in training programs. Table 2.1 is a reproduction of Moe et al.'s summary of occupational literacy requirements.

Summing Up. What can be learned from this brief, but incomplete survey, of research on the skill requirements of jobs? First, it is worth noting that a variety of terms have been used to describe skills apparently required in a variety of occupations, including basic skills, generic skills and literacy skills. However, some of these terms, most notably literacy, have been used in markedly different ways by different researchers. Second, the range of skills investigated is fairly broad, including:

reading
writing
math
reasoning
speaking, and
listening skills.

Among research inquiries reviewed, reading seems to be the commonest of the skills identified as required for a broad range of occupations. Note, however, that even for this skill, most commonly seen as necessary for occupations, methods of inquiry vary markedly, ranging from ratings of what types of reading skills are necessary for different jobs (as in the Canadian inquiry), to ratings on an ordinal scale of reading skill level required (as in the DOT supplement) to analyses of the textual materials read on the job (as in the Sticht, Moe and Mikulecky and Diehl analyses). Moreover even when common methods of inquiry have been employed (e.g. readability analyses of textual

TABLE 2.1 SUMMARY OF OCCUPATIONAL LITERACY REQUIREMENTS

	On The Job		Training Program	
	Reading	Mathematics	Reading	Mathematics
Account Clerk	College to college graduate level	addition, subtraction, multiplication, division, decimals, fractions, business machines	11th grade to college graduate	addition, subtraction, multiplication, division, fractions, decimals. algebra
Automotive Mechanic	9th to college graduate level	basic processes, decimals, fractions, measurement	9th to college graduate level	basic processes, decimals, fractions, measurement
Draftsman	10th grade to college graduate	basic processes, through geometry, algebra, trigonometry	9th grade to college level	basic processes, through geometry, algebra, trigonometry
Electrician	college to college graduate level	basic processes, throguh geometry, algebra, trigonometry	10th grade to college graduate level	basic processes, through geometry, algebra, trigonometry
Heating and Air conditioning Mechanic	10th grade to college graduate level	basic processes, decimals, fractions, measurement, algebra	11th grade to college graduate level	basic processes, fractions, decimals, measurement
Industrial Maintenance Mechanic	10th grade to college graduate level	basic processes through trigonometry	10th grade to college graduate level	basic processes, decimals, fractions, measurement
Licensed Practical Nurse	10th grade to college level	addition, and subtraction--more necessary to dispense medication	12th grade to college graduate level	addition and subtraction
Machine Tool Operator	9th to college graduate	basic processes, decimals, measurement	9th grade to college level	basic processes, decimals, measurement
Secretary	College to college graduate level	basic processes, decimals, fractions, business machines	10th grade to college level	basic processes, decimals, business machines
Welder	few materials--reading of single word information required	basic processes, fractions, decimals, measurement	8th grade to college graduate level	basic processes, fractions, decimals, measurement, algebra

Source: Moe et al, 1979, p. 53.

materials), findings seem to have varied substantially. For example, Moe et al. (1979) estimated that "college to college graduate" level reading skills are required on the job for individuals holding secretarial occupations. Yet Mikulecky and Diehl (1980) found that the level of reading skills required of "clerical sales" personnel, as determined by readability analyses of job materials, was only at the 11.2 grade equivalence level (p. 87), and the reading difficulty of job materials of "professional, technical, and managerial" personnel was even slightly lower (i.e. 11.0). Such apparent discrepancies may result from several different factors; for instance, from different ways of categorizing and sampling from different occupations, and from variants of seemingly similar methods of analysis (e.g. different readability formulae can lead to markedly different grade-level ratings of the same textual materials). But more fundamentally, we think they may represent severe limits to the very idea of determining functional requirements of jobs in a complex labor market. Recall that Fine pointed out that the education and training requirements may be defined in terms of "functional or performance requirements," "employer or hiring requirements," and "educational attainment" levels. Conceptually, these alternative definitions of occupations can be distinguished. But in a complex labor market system they clearly interact. Thus, several years ago when the U.S. Army found that volunteer recruits could not read equipment repair manuals, the solution was not simply to seek recruits with higher reading skills, but also to rewrite manuals at a level commensurate with the skills of individuals holding jobs as equipment repairmen. <u>In other words, the "functional requirements" of jobs can and do change in light of changing circumstances in the labor market.</u> This point should really not be all that surprising. After all, classical economic theory tells us that the utility of things much more concrete than skills, like physical objects (widgets are the examples commonly used in economic textbooks), cannot be analytically determined in any definitive way, but instead must be determined indirectly through their value in competitive markets. This perspective should, of course, not be overstated. A variety of research indicates that certain broad types of skills, such as reading, writing and math, whether they be called basic, generic, literacy or transferable skills, are important to success in a wide range of jobs. However, it appears that determining what levels of such skills may be functionally required for specific jobs may be an impossible task because functional relationships may change in light of alterations not only in the labor market, but also in the technology available to particular occupations. From a policy perspective too, the issue of functional basic skill requirements may not be so important as the other skill requirements (e.g. what Fine called hiring and educational attainment requirements). In a competitive labor market, with fewer jobs available than individuals seeking jobs, the more relevant policy issue is how well vocational education prepares students with basic skills commensurate with those of others with whom vocational education graduates must compete for jobs. In this light, we turn in the next section to examine the basic skills attainment of secondary vocational students.

III. BASIC SKILLS ATTAINMENT OF SECONDARY VOCATIONAL STUDENTS

How does the basic skills attainment of secondary vocational students compare with that of secondary general students? This is the general question addressed in this section. Specifically, we seek to address this question in three forms:

1. Do students who select the vocational curriculum tend at entry to the curriculum to be at the same level of basic skill attainment as the students who select the general curriculum?

2. Do students who graduate from a vocational program tend to be at the same level of basic skill attainment as the students who graduate from a general curriculum?

3. Do students participating in each curriculum tend to improve their basic skill competencies to the same extent over the duration of the high school program?

In order to answer these three questions, we sought data containing basic skills test information on vocational and general high school students for at least two time points, approximately entry to and exit from these two high school program areas. Unfortunately little high quality data of this sort were available. For example, Mertens et al (1980a,b), in their review of research since 1968 on outcomes of vocational education, found that it was impossible to conclude anything about the basic skills attainment of vocational students because of methodological problems in the few relevant studies available. Nevertheless we identified two national data sets holding potential for examining the questions of interest, namely;

- Project TALENT Special 1963 Retest Sample
- Intellectual Growth and Vocational Development Study (called the Growth Study), specifically the cohort of fifth graders in 1961 who generally graduated from high school in 1969.

No other longitudinal data sets containing relevant test data were available for more recent years at the time of our study.

Given the vintage of the data sets reanalyzed, an obvious question arises about the relevance of data on high school experience in the 1960s to educational policy in the 1980s. Clearly data which are more than 10 years old are of only indirect relevance to current issues. However, there are two reasons, other than the fact that they are the best longitudinal data available pertinent to the questions to be addressed, which make us think that these data are worthy of reanalysis.

First, these data do permit describing the process characterizing the 1960s. One of the needs of vocational education programs identified by the Panel of Consultants (1963), which prepared recommendations for the 1963 vocational legislation, was improvement in the basic skills of vocational education students. Yet empirical evidence substantiating this need at the national level was not provided at that time nor since then. Further, as already noted, the Mertens et al (1980a,b) review indicates that since the 1960s little or no empirical evidence has been available regarding the basic skills attainment of vocational students.

Second, in examining relationships of vocational education to subsequent employment outcomes, the best available national longitudinal data set is the National Longitudinal Study of the High School Class of 1972 (See Woods & Haney, 1981). Thus, the description of the basic skills attainment of vocational students during the 1960s is actually not much older than the best available data on the relationship between vocational education and employment outcomes.

In the following sections of Chapter III we describe the Project TALENT and Growth Study data sets, our reanalyses of them and the findings of these reanalyses.

3.1 Project TALENT Retest Data and Reanalyses

Project TALENT was a longitudinal study of individuals who were enrolled in grades nine through twelve in 1960.* The study was designed to include a representative sample of roughly 5% of all such individuals in the United States. To achieve this goal, a stratified probability sample of 1,003 public and private high schools was selected for study. When a high school enrolled no ninth graders, junior high schools from which high schools drew their students were also sampled. Ninety-three percent of the sampled schools agreed to participate in the TALENT study, and, at least in theory, each student in these schools was tested and answered a range of questions about their families, plans for the future and attitudes (Jencks and Brown, 1975, p. 277; Wise et al., 1979).

In 1963, all of the twelfth graders in 118 of the 822 public high schools originally sampled in 1960 were tested with a portion (about half) of the original TALENT test battery. Approximately three fourths of these students (N=7,678) had also been tested in 1960 when most of the 1963 high school seniors were in the ninth grade (Wise, et al, 1979, p.21). For the 1963 retest, private and parochial schools and nonvocational schools in the five largest cities were excluded for "administrative reasons" (Wise, et al., 1979, p.21). Otherwise the retest schools were selected so as to be representative of the original 1960 national sample of schools, and toward that end were classified according to a taxomony which grouped schools by region and type of community.** Seventeen of the 118 1963 retest sample schools were vocational high schools.

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* Project TALENT was developed by the American Institutes for Research, with support from the U.S. Office of Education and the National Institute of Education.

** Table 2.5 in Wise et al. (1979, p.20) shows the number of senior high schools in the 1960 sample, the number selected for retesting, and the number participating for each school classification. A more complete description of the Retest Sample along with the procedures used in matching to the 1960 data is given in The High School Years: Growth in Cognitive Skills (Shaycoft, 1967).

Our reanalyses of the 1963 TALENT retest sample focused on three tests which can be construed as tests of basic skills, namely

- reading comprehension
- arithmetic reasoning
- arithmetic computations

A matrix sampling design was used in the 1963 test administration, with only a subset of the sampled schools administered any one test. Seven different test batteries (see Appendix C, Shaycoft, 1967) were used. An abstract reasoning test was included in each battery as an anchor test, with each of the other selected 1960 tests included in at least three of the seven batteries. The Reading Comprehension test appeared in the batteries administered to 64 schools, and the Arithmetic Reasoning and Arithmetic Computation tests appeared together in the batteries administered to 66 schools. All three of these tests (reading comprehension, arithmetic reasoning and arithmetic computation) were administered to 29 of these schools.

Since the 1963 retest results were initially reported by Project TALENT (Shaycoft, 1967), secondary analyses of these data have been reported in only one study (namely, Jencks and Brown, 1975). No public use file for the retest sample is available from the Project TALENT Data Bank. For our purposes a special work tape file with a specified subset of variables had to be purchased from the TALENT Data Bank.* This retest work file contained a total of 7,542 matched (longitudinal) cases with test data for both 1960 and 1963.** In addition to matching data for these two test collections, 1964 follow-up data as of one year out of high school were also matched in the file for any

* Project TALENT Data Bank is administered by the American Institutes for Research, Palo Alto, California. Further information on the Data Bank is available in Wise, McLaughlin and Steel (1979).

** The matching of the test data for both the 1960 and 1963 test administrations was done by the Project TALENT Data Bank. In contrast, Jencks and Brown (1975) for their study had to do the matching themselves.

cases who responded to this follow-up. The 1964 follow-up data appended to the file were limited to self-reported high school curriculum for reasons which will be explained later.

Description of Variables. Before describing the way in which the 1963 TALENT retest sample was used in reanalyses, it is necessary to describe the variables used in the reanalyses. Specifically, we describe three sets of variables, namely curriculum self-report, basic skills test data and background information.

Curriculum Self-Report is drawn primarily from the following item which appeared in the student information blank (SIB) administered to all schools in the 1960 sample (Q-91) and about one third of the schools in the 1963 retest sample (Q-52):

> Which one of the following high school programs or curriculums is most like the one that you are taking? If you have not yet been assigned to a program, which do you expect you will take?
>
> A. General--a program that does not necessarily prepare you either for college or for work, but in which you take subjects required for graduation and many subjects that you like.
>
> B. College Preparatory--a program that gives you the training and credits needed to work toward a regular Bachelor's degree in college.
>
> C. Commercial or Business--a program that prepares you to work in an office; for example, as a secretary or bookkeeper.
>
> D. Vocational--a program that prepares you to work in a shop or factory, or to enter a trade school, or become an apprentice after high school.
>
> E. Agriculture
>
> F. A program very different from the above.

We also used the following (Q-9) item which appeared in the one-year follow-up questionnaire dated November, 1964:

In high school what course of study did you take?

General
College preparatory
Commercial or business
Vocational
Agriculture
Other (please specify)

It was necessary to use the 1964 item concerning high school program of study because only about one-third of the 1963 retest sample was administered the SIB containing the question regarding high school curriculum program in 1963.

Our general strategy for identifying high school curriculum program was to base curriculum classifications on student self-reports at both ninth grade and end of high school (either the 1963 twelfth grade retest, or the 1964 one-year follow-up responses). It should be noted that there were two significant problems in treating the curriculum self-reports for the 1964 survey as equivalent to those in the 1963 twelfth grade survey. First and most obviously the 1964 curriculum item, unlike the corresponding item in the 1963 survey, did not define the curriculum response categories. Second, examination of the 2,509 cases for which both 1963 and 1964 curriculum self-reports were available, indicated that about 23% overall gave inconsistent responses regarding high school program of study. Table 3.1 shows the extent to which the 1964 responses were consistent with 1963 curriculum self-reports, for all cases in which both items of data were available. As this table indicates, agreement ranged from a high of 88% for college preparatory, to a low of 36% (for vocational other than commercial,

TABLE 3.1: Consistency of Curriculum Self-Reports Between TALENT 1963 Retest and 1964 Follow-up Samples

1963 Twelfth Grade Sample Responses	1964 Follow-up Responses						
	General	Col Prep	Comm-Bus	Vocational	Agricultural	Other	Row Total
General	448 76.2	64 10.9	36 6.1	7 1.2	5 0.9	28 4.8	588 23.4
Col Prep	97 8.1	1051 87.8	10 0.8	2 0.2	0 0.0	37 3.1	1197 47.7
Comm-Bus	90 17.2	13 2.5	377 72.2	4 0.8	1 0.2	37 3.1	522 20.8
Vocational	44 34.1	10 7.8	11 8.5	46 35.7	4 3.1	14 10.9	129 5.1
Agricultural	14 35.9	2 5.1	0 0.0	2 5.1	18 46.2	3 7.7	39 1.6
Different Prg	18 52.9	7 20.6	4 11.8	2 5.9	0 0.0	3 8.8	34 1.4
Column Total	711	1147	438	63	28	122	2509

Source: Analyses performed by The Huron Institute on retest work file.

business or agriculture). Inconsistency may derive from both real changes in curriculum programs between the early spring 1963 survey and high school graduation, and from simple unreliability in self-reports of curriculum programs (see Woods & Haney, 1981, for a general discussion of the problem of unreliability ~~in curriculum~~ self-reports). We have no way of knowing the extent to which these two factors may have contributed to the inconsistencies. Nevertheless, two aspects of our reanalyses help to minimize problems associated with inconsistencies between 1963 and 1964 curriculum self-reports. First, most of our results focus on the general, commercial-business and college preparatory curriculum categories, all of which showed consistencies of 70% or greater. Second, reanalyses were based, as already noted, on cases for which consistent responses were given at both ninth grade and end of high school (either 1963 retest or 1964 follow-up surveys). More detail on this reanalysis criterion will be given later, but for the present let us note simply that it seems reasonable to assume that inconsistencies between 1963 and 1964 curriculum self-reports would presumably be less frequent for those who gave consistent responses between 1960 and ~~either of the~~ later dates than for those who did not.

Test data. As mentioned, for the purposes of our study, attention was focused on three TALENT tests administered in both 1960 (to ninth graders) and 1963 (to twelfth graders). Those tests, and their purposes were described as follows:

> Reading Comprehension. The purpose of this test is to measure the ability to comprehend written materials. The test includes passages on a wide range of topics.

> Arithmetic Reasoning. This test is designed to measure the ability to reason in the manner required to solve arithmetic problems. Computation, except at the simplest level, is excluded from the test.
>
> Arithmetic Computation. The purpose of this test is to measure speed and accuracy of computation. The test is limited to the four basic operations (addition, subtraction, multiplication, and division) and to whole numbers.

The reading comprehension test contained 48 items; arithmetic reasoning, 16 items; and arithmetic computation, 72 items. These tests seem to us to be fairly typical multiple-choice tests of the intended skills. The reading comprehension test, for example, is composed of reading passages of around 100-200 words, followed by five to eight questions about the passage. The exact item content of each test is provided in Project TALENT test booklets C-1 and C-2. Test reliabilities reported in Flanagan et al. (1964) for samples administered the tests in 1960 are summarized in Table 3.2 for the reading comprehension and arithmetic reasoning tests. No estimated reliabilities were reported for the arithmetic computation test by Flanagan et al. (1964) or subsequently by Shaycoft (1967). About 87% of the retest sample were reported as being administered the tests during the period March 1 to April 15 for the 1960 testing (and another 11% were missing the testing data). No test date information for the 1963 retesting appeared on the data file, but Project TALENT informed us that Marion Shaycoft recalls that the retesting was conducted in a comparable period in 1963 (i.e., principally during March and April).

Background characteristics. The retest data file contained a socioeconomic index (P-801) computed for each student on the basis of responses

TABLE 3.2: Reported Reliabilities for Project TALENT Reading Comprehension and Arithmetic Tests for 1960 Administration, Grades 9-12.

	Boys				Girls			
	Gr. 9	10	11	12	9	10	11	12
Reading Comprehension KR-21[a]	.920	.922	.926	.925	.908	.906	.911	.914
Spearman-Brown split-half[b]	.852	.853	.870	.859	.833	.825	.846	.838
Arithmetic Reasoning KR-21[c]	.711	.710	.738	.766	.676	.706	.728	.729

a. Source: Table 2-5, Flanagan et al., 1964, pp. 2-14, 2-15. Note to table states KR-21 inappropriate for reading comprehension test because items are not experimentally independent and because the test is slightly speeded (i.e., very slow readers did not finish). Values reported should be considered overestimates.

b. Source: Table 2-5, Flanagan et al., 1964, pp. 2-14, 2-15. Note (e) to table tells how done.

c. Source: Table 2-5, Flanagan et al., 1964, pp. 2-14, 2-15.

to nine items in the 1960 Student Information Blank (namely, highest level of education of mother and father, father's occupation, family income, present value of house if owned, and four household item questions). Appendix E of Shaycoft (1967) summarizes the procedures used in developing the index. The index approximates a standard score, with a mean of 100 and a standard deviation of 10.

In addition, students' responses to the items in the 1960 SIB asking for the highest level of education of mother and father (Q219 and 218, respectively) were examined. Since only one third of the schools in the retest sample were readministered the SIB in 1963, the examination was limited to responses to the 1960 SIB.

Reanalysis sample. Four criteria were used to select cases from the 1963 retest file for inclusion in the reanalysis file. First cases included in the reanalysis had to have information on end of high school curriculum. This datum was drawn either from the 1963 response regarding curriculum program in the SIB or from the 1964 follow-up question. It was necessary to use the 1964 curriculum item, because the SIB was administered to only about one-third of the retested sample. Thus if we had limited the grade twelve curriculum program identification only to the 1963 SIB, about sixty percent of the retest cases would automatically have been eliminated. However, by drawing grade twelve curriculum information from the 1964 follow-up as well as from the 1963 SIB, the number of cases eligible for inclusion in reanalyses was raised from 3,349 (44.4% of the cases in the reanalysis file) to 6,400 (84.9%). At this stage of reanalysis sample selection 1,142 cases were eliminated as not having grade twelve curriculum information from either source.

The second criterion for sample selection was that cases had to have matched reading comprehension or arithmetic test data for grade nine and twelve. Approximately 1,100 cases in the retest file did not have such matched data for either reading comprehension or arithmetic (but did have grade twelve curriculum information) and were eliminated from the reanalysis file.

The third criterion was information on race. As in our larger study (Woods and Haney, 1981), we would have liked to conduct analyses separately by race, at least for whites and blacks. However, in the Project TALENT survey individuals were asked to indicate their race only in the 1964 follow-up and not in either the original 1960 survey or the 1963 retest survey. Thus, individual racial information was available for only about 49% of the retest file cases. Therefore, we decided to adopt the strategy employed by Jencks and Brown (1975), namely to restrict the reanalysis sample insofar as possible to whites only. This was approximated by eliminating cases which were indicated to be nonwhite (i.e., Black, American Indian, or some other nonwhite race) in the 1964 follow-up, or who attended a school whose principal indicated it to be 20% or more Black (Sch Q-98). About 480 cases were eliminated for these two reasons. Using these two criteria in lieu of complete information on race at the individual level obviously is not ideal, but seemed to us as it did to Jencks and Brown, better than basing reanalyses on a sample whose racial composition was even less well specified.

After application of these three selection criteria, we were left with a sample of approximately 4,800 cases.

The final selection criterion was to retain only those cases for which grade 9 curriculum self-report was the same as the grade twelve report. At grade 9, respondents were asked "If you have not yet been assigned to a [curriculum] program, which do you expect to take?" This fourth reanalysis sample selection criterion was used for two reasons. First as suggested already it was applied as a means of overcoming the problem of unreliability in curriculum self-reports. Presumably an individual who reports a particular curriculum at both points is more likely to actually be in that curriculum program than one who reports it at only one point. Second, even if we were to assume away the problem of self-report unreliability, it would be impossible to interpret results for individuals who reported curriculum A at one time and B at another. The problem is that in the TALENT data base, no information is available on when curriculum changes took place, i.e. at grade 10, 11 or 12. A total of 2,808 (or 58.5%) of the 4,803 cases remaining after application of the first three criteria met this last criterion.

Description of Reanalysis Sample. Prior to addressing the questions of whether the basic skills attainment process appears to differ by secondary school curriculum programs, some description should be given of the population represented by the reanalysis sample used to derive the findings. While the retest sample was designed by Project TALENT to represent the nation's schools, several limitations with the representativeness of the reanalysis sample are noteworthy. In obtaining a "matched" longitudinal retest sample of students, the TALENT retest ignored any individuals who had dropped out of the sampled schools or transferred to another school between grade 9 and grade 12. In addition, any student attending the same sampled school on both occasions who was absent at the time of one of the test administrations was eliminated from the retest file. Due to the effects of dropout, transfer and absenteeism, the 1963 retest sample does not represent the same universe of individuals as that tested as 9th graders in 1960. Jencks and Brown (1975, p.280) estimated that about 15 percent of the students enrolled in the retest sampled schools dropped out between grades 9 and 12, about 15 percent transferred to another school or repeated a grade, and perhaps 8 percent were enrolled but absent on the day the twelfth grade was retested in 1963. They were unable to estimate the percent of 12th graders enrolled in 1963 who were absent on the day the ninth grade was tested in 1960. While we have test data only for those with matched data for the two time points, Jencks and Brown had data on all 9th graders originally tested in 1960 in the retest sampled schools. They concluded from an analysis of ninth graders with or without matched test data in 1963 that the retest sample differed from the original universe in the following ways:

> Taken as a group, the absentees and transfers appear to have been much like the rest of the ninth-grade sample. Those who failed to provide complete data in ninth grade and those who dropped out between ninth and twelfth grade tended to come from low-SES homes, to have low test scores, and to have less ambitious ninth-grade plans than their classmates. The retest sample is thus more advantaged than the full ninth-grade sample. It is also slightly more advantaged than a representative twelfth-grade sample, since it excludes those who omitted relevant items. However, the upward bias in the means for the retest sample does not appreciably alter either standard deviations or correlation coefficients. The regression results for the retest sample should therefore approximate those for a representative sample of seniors enrolled in predominantly white comprehensive public high schools in 1963.
>
> (Jencks and Brown, 1975, pp. 280-281)

While this provides some indication of how the matched retest sample differs from the original universe, the next question to be answered is whether any of our reanalysis selection criteria further changed the composition of our reanalysis sample. The two screening criteria we applied with respect to the particular tests administered in 1963 to each retest school should not have significantly affected the representativeness of the resulting sample, since a probability design was used in assigning the seven retest batteries to schools. However, the elimination of blacks and individuals from schools with 20% or more blacks obviously did affect the composition of our reanalyses sample.

Our final screening criterion was to restrict the reanalyses sample to individuals who reported the same curriculum program in grade 9 and 12. How this screening criterion affected sample composition was not immediately obvious. Therefore, we examined the composition of the reanalysis sample before and after imposition of this criterion. Specifically comparisons were made separately by sex in terms of percentages reporting each of four curriculum programs (general, commercial or business, other vocational, and college preparatory), average socioeconomic status, and average test scores. Results indicated that application of our fourth screening criterion led to the following changes in sample composition

- for both sexes, slightly greater percentages of individuals in the college preparatory group (6-7% more) and slightly smaller percentages (4-5% less) in the general curriculum group.

- the female other vocational group (i.e. noncommercial) showed changes in test scores of more than one-half standard deviation.

The first change seems to reflect a tendency for individuals who were consistent in reporting curriculum program of grade 9 and 12 to be college preparatory students and for those exhibiting inconsistent curriculum to be general students. This difference in consistency of curriculum reports may reflect both factors already noted, namely unreliability of self-reports and actual changes in curriculum programs. The second change is explained by the fact that there were only 28 cases in the female other vocational category after application of the fourth screening criterion. For this reason, we do not report results of reanalyses for this subgroup.

Other than these two changes, imposition of our fourth screening criterion did not change composition of sex-curriculum subgroups by as much as one-half standard deviation in terms of SES index, or average reading comprehension, arithmetic reasoning or arithmetic computation test scores for either grade nine or twelve.

The matrix test sampling design used in the 1963 retest resulted in two different groups taking the reading and arithmetic tests, though a subset of students did take all three tests. Since basic skills attainment results will be reported by these two groups (i.e., composed of students with matched reading test scores and students with matched arithmetic test scores), background characteristics for the final reanalysis sample were examined for these two groups separately by sex and curriculum group. Table 3.3 shows the numbers of cases represented in each of these groups, plus the average SES and grade 9 abstract reasoning (9AR) scores for each subgroup. Note that the SES and 9AR scores vary only very little between the reading and arithmetic samples, precisely what was expected since the schools administered the reading and arithmetic tests at grade 12 were selected probabilistically. We also examined the averages

TABLE 3.3: Project TALENT Retest Reanalysis Sample. Size, and Average SES and Ninth Grade Abstract Reasoning Scores*

	Reading Test Sample			Arithmetic Test Sample			Total Sample		
	N	SES	9AR	N	SES	9AR	N	SES	9AR
Male-General	184	94.7	7.82	189	94.3	7.95	324	94.6	7.96
Commercial	34	94.4	6.76	27	96.3	6.93	45	94.6	6.98
Voc other	109	92.9	8.19	107	92.2	8.04	70	92.3	7.99
Coll. Prep.	520	103 6	10.39	475	102.6	10.20	823	103.2	10.28
Female-General	92	95.3	8.04	122	94.7	7.43	189	95.2	7.64
Commercial	308	96.0	8.31	271	95.2	8.42	480	95.5	8.32
Coll. Prep.	450	104.9	10.16	424	104.7	10.10	748	104.7	10.05
Totals	1719	100.2	9.08	1639	99.5	9.17	2808	99.9	9.23

* The female other vocational group has been deleted, as explained in the text due to small sample size. The within sex curriculum group standard deviations varied from 8.6 to 9.6 for SES, and from 2.2 to 3.0 for grade 9 Abstract Reasoning Test Scores.

on four other variables across the 21 subgroups listed in Table 3.3, specifically

Grade 9 reading comprehension
Grade 9 arithmetic computations
Grade 9 arithmetic reasoning
Grade 12 abstract reasoning.

As with SES and 9AR, on these variables we found only very small differences between the reading test, math test and total samples for each of the seven sex-curriculum subgroups. Thus, it seems reasonable to conclude that if the pattern of basic skills attainment varies among the curricular groups we intend to compare, differences are not very likely due to the way in which we selected the reanalysis sample, in particular by selecting cases which had matched reading or arithmetic test scores. In this regard, note too that the average SES scores for the reading, arithmetic and total samples reported in Table 3.3, vary by no more than about one twentieth of a standard deviation from the overall grand SES average of 100 for the total 1960 TALENT sample. This suggests that our reanalysis sample is fairly typical of the nationally representative total TALENT sample of 1960 ninth graders, except of course for our restrictions on the reanalysis sample with regard to race.

Reanalyses. Two types of analyses were performed on the Project TALENT reanalysis sample, what we call cross-tabular analyses and regression analyses. We will describe each and the results of each separately. Also we will describe results of a graphical analysis even though for the sake of economizing on space we will not actually present graphs of score distributions.*

* All analyses, as well as reanalysis sample file preparation were performed at the Harvard University Computation Center. SPSS was used in all statistical calculations, and SAS was used to prepare some graphs.

Cross-tabular analyses. For these analyses, we simply calculated means, standard deviations and raw score differences between grade 9 and 12 for all seven sex-curriculum subgroups for each of three tests examined. Results are shown in Tables 3.4, 3.5 and 3.6. There are many ways in which the data presented in these three tables could be compared. We will discuss them in a manner corresponding to the three questions set out at the beginning of chapter 3, concerning grade 9 comparisons, grade 12 comparisons, and grade 9-12 changes.

Considering grade 9 average scores between curriculum subgroups, we see that differences between general and vocational groups, compared separately by sex, are relatively small. Across all three tests such differences never come close to equaling one-half standard deviation of the total sample. The largest difference between general and vocational subgroups at grade nine is between the male general subgroup and the male commercial subgroup, where the difference of 3.51 in average arithmetic computation scores is equivalent to .42 standard deviations in terms of the variance of the total reanalysis sample on arithmetic computation scores. One caveat should be noted with respect to the male commercial subgroup, however. As reported in Table 3.3, this subgroup has a fairly low number of cases, specifically 27 for arithmetic scores and 34 for reading comprehension scores.

In contrast to the similarity of grade nine test scores between general and various vocational subgroups, it is worth noting that the college preparatory subgroup is consistently higher -- about one standard deviation higher than general for reading comprehension and arithmetic reasoning test scores for both sexes and around one-half standard deviation higher than general on arithmetic computation test scores.

TABLE 3.4: Reading Comprehension Test Scores, Grade 9-12, By Sex-Curriculum Subgroup*

		Grade 9		Grade 12		Grade 12-9
		Mean	St.Dev.	Mean	St.Dev.	Difference
Male	General	23.36	9.24	30.43	9.20	7.07
	Commercial	23.62	8.23	27.50	8.55	3.88
	Other Voc	20.69	7.67	27.66	8.58	6.97
	Coll. Prep.	33.74	8.80	39.52	8.16	5.73
Female	General	26.43	9.27	32.16	9.67	5.73
	Commercial	25.67	8.35	31.64	8.19	5.97
	Coll. Prep.	35.35	7.81	40.91	5.98	5.56
Grand Total		30.03	9.98	35.95	9.36	5.92

* Project TALENT Reanalysis Sample, for sample sizes of subgroup, see Table 3.3.

TABLE 3.5; Arithmetic Reasoning Test Scores, Grade 9 and 12, By Sex-Curriculum Subgroup*

		Grade 9		Grade 12		Grade 12-9
		Mean	St.Dev.	Mean	St.Dev.	Difference
Male	General	7.16	2.98	9.18	3.22	2.02
	Commercial	6.32	2.84	9.22	3.08	2.90
	Other Voc	6.50	2.81	8.32	3.55	1.82
	Coll. Prep.	10.47	2.89	12.35	3.07	1.88
Female	General	6.89	2.69	8.39	3.47	1.50
	Commercial	7.23	2.85	8.85	3.12	1.62
	Coll. Prep.	9.86	2.98	11.53	2.96	1.67
Grand Total		8.78	3.33	10.52	3.54	1.74

* Project TALENT Reanalysis Sample, for sample sizes of subgroup, see Table 3.3

TABLE 3.6; Arithmetic Computation Test Scores, Grade 9 and 12, By Sex-Curriculum Subgroup*

		Grade 9		Grade 12		Grade 12-9
		Mean	St.Dev.	Mean	St.Dev.	Difference
Male	General	33.58	8.48	41.19	10.60	7.61
	Commercial	37.09	7.35	42.30	11.92	5.21
	Other Voc	32.60	7.62	37.79	11.23	5.19
	Coll. Prep.	38.24	7.49	46.25	9.82	8.01
Female	General	36.39	7.88	42.14	10.28	5.75
	Commercial	38.00	8.05	44.21	10.18	6.21
	Coll. Prep.	41.13	8.58	47.54	8.97	6.41
Grand Total		37.93	8.45	44.65	10.27	6.72

* Project TALENT Reanalysis Sample, for sample sizes by subgroup see Table 3.3.

At grade twelve a similar pattern holds. Average test scores between general and vocational subgroups are fairly similar (consistently within a half-standard deviation), but the college prep subgroups on average tend to score one-half to one standard deviation above both general and the various subgroups.

When we look at average grade 9 to grade 12 differences, a slightly different pattern emerges. For reading comprehension, all subgroup differences are in the range of 5.6 to 7.1 with the exception of the male-commercial subgroup, with a difference of only 3.9. However as previously noted this subgroup contains only 34 cases. For arithmetic reasoning, gain scores are likewise similar: 1.50 to 1.67 for the three female subgroups, and 1.82 to 2.90 for the male subgroups -- with the male-commercial subgroup having only a small number of cases (n = 27). Arithmetic computation difference scores show a slightly different pattern, with the male vocational subgroups showing a slightly lower increase (5.21 and 5.19 for commercial and other vocational males respectively) than general (7.61) and college prep (8.01) males. These differences are, however, equivalent to less than one-third of the standard deviation of grade 12 arithmetic computation scores. Female subgroups showed even less variation in grade 9-12 arithmetic compuration difference scores ranging from only 5.75 to 6.41 points.

Graphical Analyses. Prior to conducting regression analyses on the reanalyses sample we constructed and examined graphs of the distributions of reading comprehension, arithmetic reasoning and arithmetic computations of both grade 9 and grade 12, for all seven sex-curriculum subgroups. We do not present all 42 distributions here so as to save space. but instead simply present overall findings from our examinations of these graphs. As expected from the cross-tabular results, test score distributions for all three tests and all seven sex-curriculum subgroups showed a shift to the right between grade 9 and grade 12 -- simply a reflection of the fact that scores on all three tests tend to increase notably between entry into and exit from high school. From the graphs of test score distributions we also noted that most distributions were relatively normal in appearance. However, two exceptions from normal distributions were apparent. First, in several cases outliers were apparent. For example, in one twelfth grade reading comprehension score distribution with a mean of 30.1, and 98% of the cases scoring between 9 and 48, two cases showed a score of only one. Second, four distributions were markedly skewed toward the right, that is with relatively large numbers of cases bunched together near the higher end of the score range. The four score distributions showing this phenomenon were:

Grade 12 Male College Prep Reading Comprehension
Grade 12 Female College Prep Reading Comprehension
Grade 12 Male College Prep Arithmetic Reasoning
Grade 12 Female College Prep Arithmetic Reasoning

Another way of describing this phenomenon is to say that there was a ceiling effect on these tests, with most grade 12 college prep students getting most of the items on these tests correct. In other words, there were not a sufficient number of hard items on these tests to produce a normal distribution for some groups of twelfth graders.

The phenomenon of ceiling effects on grade 12 TALENT tests was previously noted and discussed by Jencks and Brown, who observed that in some cases there were negative correlations between grade nine scores and gains between grade nine and twelve:

> This suggests that there may have been ceiling effects on these six tests. Yet very few twelfth graders got every item on every test but one correct. The average reliability was, moreover, as high for twelfth grade as for ninth grade scores. Any ceiling effects must, then, have been of a fairly unusual kind. Whereas "easy" items on these tests must have been such that almost everyone who did not know them in ninth grade learned them by twelfth grade, the "hard" items must have been such that even clever students were not likely to master them between ninth and twelfth grades.
> (Jencks & Brown, 1975, pp.282-83)

It should be noted that in their analysis, Jencks and Brown did not differentiate students by curriculum subgroup. Also, they employed more than just the three basic skills tests we are using.*

Regression reanalyses. Results reported so far are the products of fairly primitive methods of analysis. Simple descriptive cross-tabulation results do not, for example, correct for any initial differences in the characteristics of the various sex-curriculum subgroups. Therefore, we undertook a set of regression analyses which would help account for such differences. Our strategy was to use data on general students to develop equations for predicting grade 12 scores. These equations were then applied to data on vocational and college preparatory students to produce

* One puzzling aspect of the relationship between ceiling effects and correlations between grade nine scores and grade 9-12 gains relates to the arithmetic computation test. While Shaycroft (1967, p.5-10) reports the grade 9 x grade 12 correlation to be even more negative for the arithmetic computation test (-.52 and -.42 for males and females) than for the reading comprehension (-.26 and -.29) and the arithmetic reasoning (-.05 and +.08), the grade 12 arithmetic computation scores do not appear to be nearly as skewed (i.e., not as much ceiling effect) as do the other two tests.

predicted grade 12 scores. We then looked at differences between predicted and actual grade 12 scores, to determine whether vocational students gained any more or less than predicted on the basis of performance of general program students.

This was our general strategy in performing regression analyses on the TALENT reanalysis sample. However, before presenting the results of these reanalyses several details should be explained. First, it should be noted that prediction equations were constructed and applied separately for males and females. Second, in constructing prediction equations, we dropped outlying cases, since such outliers can strongly influence and potentially bias regression results. Third, three different prediction equations were developed for each sex and type of grade 12 test score. The three types of prediction equations were intended to control for increasing amounts of information on students. Specifically, the three prediction equations controlled for:

(1) grade 9 test scores

(2) grade 9 test scores and student SES

(3) grade 9 test scores, SES, and a cluster of school characteristics (specifically percentage of school student body which is black, school size, retention ratio, and population size of community in which school is located).

Table 3.7 shows summary statistics for all eighteen prediction equations employed. As these data suggest, among those variables tried, the most important in predicting grade 12 scores were the corresponding grade 9 scores. Also, females' grade 12 scores invariably were predicted with greater precision (i.e., higher R^2) than males twelfth grade scores, and reading comprehension scores showed more predictability (i.e. higher R^2) than either of the arithmetic scores. Also it should be noted that in all instances the number of cases

TABLE 3.7: Summary Statistics for TALENT Prediction Equations. Developed Using Data On General Program Students*

Test Score Predicted and Prediction Variables	Males					Females				
Reading Comprehension-Gr 12	N	Constant	b (gd.9 test)	R	R^2	N	Constant	b(gd.9 test)	R	R^2
Equation 1 Grade 9 R.Comp.	169	16.240	.638	.691	.477	85	10.022	.847	.874	.763
2 Grade 9 R.Comp. & SES	168		.630	.692	.479	85		.839	.874	.764
3 Grade 9 R.Comp., SES and School Vars.[a]	133		.625	.689	.474	59		.864	.895	.801
Arithmetic Reasoning-Gr 12										
Equation 1 Grade 9 Arith Reas.	184	4.623	.668	.585	.342	110	3.363	.797	.640	.409
2 Grade 9 Arith Reas. & SES	183		.640	.592	.350	110		.731	.684	.467
3 Grade 9 Arith Reas., SES, and Sch.Vars.[a]	115		.624	.595	.354	67		.805	.710	.505
Arithmetic Computations-Gr 12										
Equation 1 Grade 9 Arith Comp.	178	14.056	.819	.611	.374	114	13.022	.791	.649	.421
2 Grade 9 Arith Comp. & SES	178		.819	.611	.374	114		.779	.662	.438
3 Grade 9 Arith Comp., SES, & Sch. Vars.[a]	109		.878	.655	.429	70		.922	.807	.652

* Numbers of outlying cases deleted prior to developing the prediction equations were reading comprehension 9M, 6F; arithmetic reasoning 4M, 10F; arithmetic computation 10M, 7F. In all regression equations, pretest scores were statistically significant (at the 0.05 level), but in only some cases were other predictor variables significant. Specifically, SES was significant in prediction equations 2&3 for females for arithmetic reasoning, and community size was significant in equation 3 for females for arithmetic computations.

a School variables included: percentage of school student body which is black; school size; retention ratio; and population size of community in which school is located.

drops substantially from the second to the third prediction equations. This was because of missing data on some of the school variables used in the third type of prediction equation.

These prediction equations, developed using only data on general curriculum students were then applied to predict the grade 12 test scores of other curriculum program students. Predicted grade 12 test scores were then subtracted from individuals' actual grade 12 test scores to give residuals which indicate how much more or less other curriculum program students scored in grade 12 than predicted on the basis of performance of general program students. These residuals were calculated in two forms, in terms of raw scores (number of problems correct on each type of test) and z-scores (raw score residuals divided by the standard deviation for each type of test).

Table 3.8 shows the average residuals, both raw score and z-score, for each of the following types of curriculum programs:

- commercial
- other vocational
- academic

except that, as previously noted, results for the female "other vocational" category have been deleted due to small sample size.

Two aspects of these results are striking. First, very few of the average residuals are as large as one half standard deviation, and these are almost all for the male commercial group, a group comprised of a relatively small sample, only 20 to 34 individuals depending on which test and which prediction equation is considered. If we discount the male commercial group because of these relatively small sample sizes. we see that average

TABLE 3.8: Average Residuals for Grade 12 Test Scores, By Curriculum Program Sex, and Type of Prediction Equation.*

Raw-score residual, Z-score residual and sample size.

Reading Comprehension		Males Comm.	Males Other Voc.	Males Coll. Prep.	Females Comm.	Females Coll. Prep.
		-3.8	-1.8	2.1	-0.1	0.9
Equation	1	-0.7*	-0.3	0.4	-0.0	0.2
		34	109	515	307	447
		-3.8	-1.5	1.8	-0.1	0.7
	2	-0.7*	-0.3	0.3	-0.0	0.2
		34	107	514	307	447
		-2.8	-1.0	3.2	0.7	0.6
	3	-0.5*	-0.2	0.6*	0.2	0.1
		25	63	349	222	307
Arithmetic Reasoning						
		0.6	-0.5	1.0	-0.2	0.5
Equation	1	0.2	-0.2	0.4	-0.1	0.2
		27	106	473	269	423
		0.5	-0.5	0.8	-0.2	-0.1
	2	0.2	-0.2	0.3	-0.1	-0.0
		27	106	473	269	422
		1.5	-0.2	1.0	-0.7	-0.2
	3	0.6*	-0.1	0.4	-0.3	-0.0
		20	71	296	210	258
Arithmetic Computations						
		-1.5	-1.8	0.6	1.0	2.2
Equation	1	-0.2	-0.3	0.1	0.1	0.3
		27	106	474	271	424
		-1.4	-1.8	0.6	1.0	1.0
	2	-0.2	-0.3	0.1	0.1	0.1
		27	106	474	271	423
		-0.5	-1.3	-0.2	1.3	2.2
	3	-0.1	-0.2	-0.0	0.2	0.4
		20	71	296	212	258

* Z-score residuals of 0.5 or greater are marked with an asterisk. Sample sizes within sex-curriculum group vary because of missing data.

residuals for other curriculum groups consistently are less than one-half standard deviation different than predicted (on the basis of general program students with comparable grade 9 test scores, SES, and school characteristics.) Second, it is worth noting how little the residuals change across the three different prediction equations. This result is, however, not terribly surprising given how little additional variance SES and school characteristics were shown to explain above and beyond grade 9 pretest scores in the regression analyses for general program students, which provided the prediction equations used in deriving the results shown in Table 3.8. There appears to be a slight tendency for males in the college prep. curriculum group to perform slightly better (0.3 to 0.6 residual z-scores) on grade 12 reading comprehension and arithmetic reasoning tests than comparable general program males, and this difference presumably might have been greater if there had been no ceiling effect apparent on these two subtests for college prep males. But in the comparison of primary interest for our purposes, namely vocational program students with general program students, we see that other vocational males and commercial females scored on grade 12 reading comprehension, arithmetic reasoning and arithmetic computations tests, very similarly (i.e. within 0.3 residual z-scores, on average) to what was predicted on the basis of comparable general program students. We interpret these results to mean that evidence available in the TALENT reanalysis sample indicates that vocational program students gained about the same in basic skills (as represented in TALENT reading comprehension, arithmetic reasoning and arithmetic computations test scores), on average as did general program students.

3.2 The Growth Study Data Set and Reanalyses

The Study of Academic Prediction and Growth, under the sponsorship of Educational Testing Service and the College Entrance Examination Board, was designed in 1959. The major external support for continued research of the study (under the name, Study of Intellectual Growth and Vocational Development) was provided by the U.S. Office of Education for the period April 1, 1966 to June 3, 1970. Other sources of funding are summarized by Hilton (1979).

A probability sampling design was not used to select the schools which participated in the study. A purposive sample of 27 schools (representing 17 communities) was selected to "provide a range of geographic locations, size of system and proportion of senior class graduates who subsequently attended college" (Hilton, 1971, p. 9). Although the schools "were not randomly selected from the population of high schools in the United States, comparisons that have been made with national probability samples indicate that the Growth Study sample fairly closely approximates randomly selected samples in aptitude and achievement. (e.g., the Coleman EEOS survey)" (Cook and Alexander, 1979, p. 29). However, while the characteristics of individuals attending the sampled schools appear to approximate those of national probability samples, the characteristics of the sampled schools do not. Hilton (1979, p. 29) reported that a comparison of the school characteristics of The Growth Study Sample with the demographic characteristics of the nation's schools indicated the Growth school sample is deficient in its representativeness of small rural high schools.*

* Hilton also suggested, however, that "this is not regarded as serious for most analytical purposes."

Although all the sampled public high schools were comprehensive, the proportion of students enrolled in a vocational education curriculum varied markedly among the schools. The average enrollment in vocational programs in the sampled schools was reportedly about 40 percent (Hilton, 1971, p. 9; Hilton, 1979, p.29). The high schools in the sample, grouped by region of the country and 12th grade enrollment, are listed in Table 3.2.1. The Growth Study sample consisted of the students in these public high schools and in all the junior high schools and elementary schools feeding into them.

Test data were collected in the sampled schools in the fall (Sept-Oct) and winter (Jan-Feb) every two years beginning in fall 1961 through fall 1968. In fall 1961 all students in grades 5,7,9, and 11 were tested; subsequently, the same students who were still in attendance, were tested every two years until they graduated from high school. Thus a total of four cohorts underly the study's longitudinal design:

Cohort	Grade in fall 1961	Anticipated Graduation Class Year
1	11	1963
2	9	1965
3	7	1967
4	5	1969

The testing plan for these cohorts is described in Table 3.2.2.

Whenever test administrations were conducted after fall 1961, all students enrolled in the designated grades in the sampled schools were tested, except those not in attendance because of prolonged illness or those classified as "mentally retarded." In this way cross-sectional data were collected at each time point. In all, 45,901 students took one or more tests as part of the in-school data collection (Hilton, 1979, p. 31).

TABLE 3.2.1: The Growth Study Sample of High Schools[a]

New England and Middle Atlantic	North Central
Over 200	**Over 200**
Erie, Pennsylvania: East High School Memorial Technical High School Academy High School Strong Vincent High School	Akron, Ohio: South High School Hower Vocational High School Kenmore High School Buchtel High School Firestone High School (added to sample in 1963)
100-200	**100-200**
Lynnfield, Maryland: (dropped out in 1962)	Mt. Healthy, Ohio
Under 100	**Under 100**
Ipswich, Maryland Warwick Valley, New York Cohasset, Maryland	Frazee, Minnesota Bronson, Michigan W. Lafayette, Indiana

South Atlantic and South Central	Mountain Pacific
Over 200	**Over 200**
Atlanta, Georgia: W.F. George High School (dropped out in 1965) Dykes High School (dropped out in 1962)	Oakland, California: Castlemont High School Oakland High School Skyline High School
100-200	**100-200**
Yazoo City, Mississippi	La Junta, Colorado
Under 100	**Under 100**
Havre de Grace, Maryland Lampasas, Texas Canyon, Texas (dropped out in 1963)	Elma, Washington Burton, Washington

[a] Source: Hilton 1979, pp. 29-30. Hilton also noted, "In addition to the public schools described above, the students in six independent schools were tested in grades 9, 11 and 12. These schools were Baylor School, Chattanooga, Tennessee; Choate School, Wallingford Connecticut; Culver Military Academy, Culver, Indiana; Harvard School, North Hollywood, California; Loomis School, Windsor, Connecticut; and Phillips Exeter Academy, Exeter, New Hampshire. Relatively few studies have made use of the independent school data."

TABLE 3.2.2: Testing Plan for the Growth Study: Cohorts 1-4

Grade in which Tested	1961 Sept-Oct	1963 Jan-Feb	1963 Sept-Oct	1965 Jan-Feb	1965 Sept-Oct	1967 Jan-Feb	1967 Sept-Oct	1968 Jan-Feb
Grade 5	4							
7	3		4					
9	2		3		4			
11	1		2		3		4	
12		1		2		3		4

Most analyses based on the Growth Study data file have been restricted to Cohort 4, which includes students who were ~~first~~ tested as 5th graders in fall 1961 and last tested as 12th graders in winter 1969 (see Table 3.2.2). A total of 8,939 fifth graders were tested in 1961 for Cohort 4. Of these, 3,476 (38.9%) in Cohort 4 have complete data for grades 5,7, 9, 11, and 12 (Hilton 1979, p. 31). This shrinkage of about 60% reflects not only the high mobility of students from one school to another but also the drop out of students from high schools. Some of the shrinkage is also due to some students missing one or more test administrations. Hilton (1979, p. 30) estimates that "by the time of each subsequent testing, about 20 percent of each cohort had left the sample school system or, for one reason or another, were not tested." When students left the "Growth Study" schools, no effort was made to follow them, primarily for financial reasons (Hilton, 1979, p. 30).

A tape copy of the master data file for Cohort 4 was acquired from ETS for our study. ETS has frequently released copies of this file to qualified researchers (see Hilton, 1979, pp. 36,42).

Description of Variables

Test Data. The test data examined in our reanalysis are the reading, mathematics and writing tests of the Sequential Tests of Educational Progress, which were administered in grades 7, 9, and 11.* Forms of the STEP administered to Cohort 4 were as follows:

Grade	STEP
7	Form 3B
9	Form 3A
11	Form 2B

* Cohort 4 was also administered the STEP in grade 5. Aptitude (PSAT/SAT) and achievement test (CEEB) data were also collected from Cohort 4 as 12 graders.

Lower level STEP forms are scored on the same continuous scale as higher level forms (i.e., the forms are vertically equated).

The STEP reading, mathematics and writing tests were designed to measure the following skills:

Reading comprehension: abilities to reproduce ideas, to tranlate ideas and make inferences, to analyze motivation, to analyze presentation and to criticize.

Mathematics: mastery of the following broad mathematics concepts; number and operation, symbolism, measurement and geometry, function and relation, deduction and inference, and probability and statistics.

Writing: ability to think critically in writing, to organize materials, to write material appropriate for a given purpose, to write effectively and to observe conventional usage in punctuation and grammar.

Little documentation on the STEP tests is provided in the Growth Study reports. However, the Technical Report for the STEP reports the following reliabilities (KR-20) for the STEP tests used in our reanalyses:

Test	Form	Grade	Reliability
Reading	2A	11	.92
	3A	8	.90
Writing	2A	11	.85
	3A	8	.88
Math	2A	11	.84
	3A	8	.83

Reliability for B forms are not reported, though the Technical report notes that the form A "results should characterize the B forms reasonably well, since the A and B forms are very similar in content" (ETS, 1957, p. 9-10). Reviewers have given the STEP battery generally favorable reviews (See Buros, 1959, 24, 207, 438, 653), though some have questioned the extent to which the STEP measures specific skill achievement as opposed to more general scholastic ability.

Hilton (1979) described the collection of test data for the Growth Study as follows:

> The data collection was conducted essentially as a small ETS testing program. Test materials and questionnaires were shipped to the participating schools in the early fall with instructions that the tests be kept under secure conditions. Each administration consisted of approximately fifteen hours of testing. The tests typically were administered by classroom teachers who were provided with detailed instructions on exactly how to handle the materials and conduct the testing. A coordinator in each school, usually a member of the guidance department, supervised the test administrations. The very small fraction of unusable answer sheets received suggests that the test administrators were unusually successful in conducting orderly test sessions.
>
> The scheduling of the test administrations was left to the schools, some of which set aside two or three full days for the data collection while others spread it over several weeks. Typically, the schools conducted one make-up session for students who were absent from a particular test administration. Some schools used auditoriums, gyms, or cafeterias for the test administration while others used classrooms.
>
> (pp. 34-5)

The years of the test administration for Cohort 4 were reported in Table 3.2.2. The specific testing intervals for this cohort were:

Grade 7	Sept-Oct	1963
9	Sept-Oct	1965
11	Sept-Oct	1967

Curriculum Identification. A Background and Experience Questionnaire (BEQ) was administered to Cohort 4 as 9th graders in fall 1965 and as 11th graders in fall 1967. In this BEQ,* students were asked to identify their course of study as follows:

(1967 Grade 11) 125. From the list below, which course of study are you taking in high school?

A. Academic or college preparatory
B. Agricultural
C. Business or commercial
D. General
E. Home economics
F. Vocational
G. Other
H. Undecided

In 1965, the item for 9th graders read: "Which course of study do you plan to take in high school." The same options were provided.

In addition to the reports of the students' curriculum drawn from the BEQ, the master data tape for Cohort 4 contained another source of curriculum information for each of grades 9, 11 and 12. The tape documentation identified these curriculum data as "obtained from student reports independently from the student reports obtained in the BEQ instruments." No further

* The twelfth grade form of the BEQ was given only to 1963 seniors. The 1965, 1967 and 1969 seniors completed a shortened form, in which they were not asked to identify their course of study (Hilton, 1979, p. 32). However, the master data tape recorded responses to the 12th grade BEQ curriculum question for 616 students in Cohort 4.

information on the latter source is provided. For purposes of this study, in order to identify the curriculum for as many students as possible, both sources were drawn on, with the BEQ response given priority. If a valid code was not reported for the BEQ item, the independent source response was used. Although the overall curriculum classification was improved by drawing on both sources, missing data on the final classification for each grade level ranged from a low of 44.3% for grade 9 to a high of 58.9% for grade 12 for the total cohort 4 sample (see Table 3.2.3).

As described above, students identified their curriculum program from a list of seven categories. Our reanalyses are based on four categories, with four of the original ones pooled into "other vocational" as follows:

1. General
2. Business or commercial
3. Other Vocational (i.e., agricultural, home economics, vocational and other pooled)
4. Academic (or college preparatory)

The reason for collapsing the categories noted into a general "other vocational" rubric was the small number of cases within the smaller categories.

Most of our reanalyses are based on the grade 9 curriculum item and a curriculum composite variable derived from the grade 11-12 curriculum information. Of the total cases in the initial reanalysis sample, about 93 percent of the grade 11-12 data were based on the grade 11 information, with priority given to the BEQ response in cases in which information was reported from both the BEQ and the independent source.

TABLE 3.2.3: Source of Self-Report Curriculum Classification of Grand Total Cohort 4 (N=14,706)

Curriculum Classification		BEQ Item (Stage 1)	"Independent" Item (Stage 2)	Missing Data
Grade 9	N	6505	1681	6520
	%	44.2	11.4	44.3
Grade 11	N	6706	142	7858
	%	45.6	1.0	53.4
Grade 12	N	616	5428	8662
	%	4.2	36.9	58.9

[a] Source: Analyses performed by The Huron Institute on Master data file.

Race. Treatment of racial information in the Growth Study was described as follows:

> Because at the time the Growth Study was begun the sociopolitical climate was such that it was not feasible to include an item for self-identification of ethnic group, the identification was accomplished several years later by engaging school guidance counselors who knew the students to make the identification from school rosters. After the students were graduated from high school in 1969, the Growth Study staff repeated the process, using high school yearbooks as the source of identifying information. In the few cases where there were disagreements between the staff and the counselors (less than 1 percent) the student in question was classified as white. Thus the "white" category--while mostly white students--also includes Mexican-Americans, Orientals, Latin-Americans and students whose identification was uncertain. . .
> (Hilton, 1979, p. 33)

About 60% of the students in the Cohort 4 sample remained unclassified at the end of this process (see Table 3.2.4).

Analyses in this study are restricted to two categories: Black and "predominantly" White. The latter category was formed by pooling those reporting they were white with those for whom no classification was obtained. Those who reported they were Oriental were deleted from the analyses, as will be described in the next section.

Background Characteristics

Questions on the students' background included in the BEQ focused on the education and occupation of their parents and the amount of encouragement and support given by parents (Hilton, 1979, p. 32). The 9th and 11th grade data are drawn on in this study. Specifically father's and mother's highest educational level was reported in the BEQ in response to items like the following;

TABLE 3.2.4: Race Classification of Grand Total Cohort 4 Sample[a]

	N	%
White	4715	32.1
Black	1063	7.2
Oriental	160	1.1
Missing Data	8768	59.6
	14706	

[a] Source: Analyses performed by The Huron Institute on master data file.

How much formal education does your father or male guardian have?

A. Grade school
B. Some high school
C. Graduated from high school
D. Some college, junior college, business or trade school (after completing high school)
E. Graduated from college
F. Some graduate or professional school (e.g., law, medicine)
G. Obtained a graduate or professional degree
H. Don't know

One composite variable for the educational level of each parent was constructed from the grade 9 and 11 BEQ responses, with priority given to the 11th grade response. Even drawing on both sources, about 40 percent of the total Cohort 4 sample did not respond to either the grade 9 or grade 11 item or responded they did not know (see Table 3.2.5).

In addition, the master data file contained a variable referred to as "family press" score. This score was reported for Cohort 4 as 9th graders (1965) and 11th graders (1967). Scores ranged from 14-51. No description of the construction of the "family press" variable is provided in Growth Study documentation, but presumably it is some aggregation of data concerning parents encouragement and support of students, as reported in the BEQ. No "family press" (FP) score was reported for 49.4% of Cohort 4 as 9th graders or for 57.2% as 11th graders.

The Growth Study provided no composite SES variable, so as will be explained below, we tried using the FP data as a control variable in some of our regression reanalyses. If a student had an FP score reported for both grade 9 and 11, the grade 11 score was used in these analyses.

TABLE 3.2.5: Highest Educational Level of Mothers and Fathers, Grand Total Cohort 4 Sample[a]

		A. Mother's Education as of Gr11 or Gr 9		B. Father's Education as of Gr11 or Gr 9	
Category Label	Code	Absolute Freq	Relative Freq (Pct.)	Absolute Freq	Relative Freq (Pct.)
Grade School	1	598	4.1	860	5.8
Some H.S.	2	2111	14.4	2130	14.5
H.S. Grad	3	3545	24.1	2673	18.2
Some Sch H.S.	4	1459	9.9	1358	9.2
College Grad	5	871	5.9	1012	6.9
Some Grad, Prof	6	190	1.3	200	1.4
Grad, Prof Deg	7	259	1.8	595	4.0
	0	5105	34.7 missing	5149	35.0 missing
Don't Know	8	568	3.9 missing	729	5.0 missing
	TOTAL	14706	100.0	14706	100.0
			38.6 % unclassified		40.0 % unclassified

[a] Source: Analyses performed by The Huron Institute on master data file.

Reanalysis Sample

The Growth Study master data file for Cohort 4 which we obtained from ETS contained a total of 14.706 cases. Our goal in reanalyzing the Growth data was to compare the basic skills attainment of vocational and general students between ninth and eleventh grades. The 9th and 11th grade data points correspond roughly to entry into and exit from high school curriculum programs. However, it should be noted that the timing of the Growth Study testing was not ideal for our purposes. Recall that the testing was done in Sept-Oct of each school year. Thus both 9th and 11th grade data represents start of school-year information. Core courses in vocational education programs usually are offered in grades 10 to 12. This raises two problems in terms of using the Growth Study grade 9 and 11 data as approximations to data on entry into and exit from vocational programs. First, the grade 9 data represents information nearly a full-year prior to entry into a grade 10 vocational program; not nearly so advantageous as the March-April ninth grade data provided in the Project TALENT data set. Second, the Sept-Oct grade 11 data represents a time point presumably only about half way through a grade 10-12 vocational program career. Again, for our purposes this timing is much less advantageous than the March-April grade 12 testing employed in the Project TALENT survey. These two points should be clearly kept in mind with respect to our reanalyses. They mean at a minimum that our reanalyses of GROWTH data are more pertinent to the basic skills attainments of vocational students <u>in grades 9 and 10</u>, than to their attainments across the full high school span of grades 9-12 or 10-12.

With this key point in mind, here is how we went about selecting a reanalysis sample. Our strategy in developing the reanalysis sample was analogous to that used regarding Project TALENT; that is we first selected on a set of initial criteria (stage 1) and then selected only those cases which showed a consistent curriculum classification between grade 9 and 11. Our initial (stage 1) selection criteria were:

1) STEP test data for grade 11
2) Curriculum information for grade 11 or 12 (reported in terms of either the BEQ or the independent source)
3) Race classified as white or black; or unclassified.

The first selection criterion was a key one. Of the 14,706 cases in the Cohort 4 file, only 7,365 had grade 11 test data. The reason for the difference is that the file contains cases for all individuals for whom data were available at grades 5, 7, 9 <u>or</u> 11. Thus even though 7,365 represents only about 50% of the total cohort 4 Growth population, it represents nearly the entire population of students who were in grade 11 in the 17 sample schools in Sept-Oct of 1967. Application of our next two selection criteria (i.e., regarding race and curriculum information) reduced the sample only slightly; from 7,365 to 6,914. In other words, the last two of our initial selection criteria (end of stage 1) led to deletion of only 451 or 6.1% of the cases with grade 11 test data.

Our final selection criterion was the analogous to that used with the TALENT data set, namely that cases had to have consistent curriculum program identifications in grade 9 and in grade 11-12. This criterion (what we call selection stage 2) further reduced the sample size from 6914 to 3155 (or approximately 54%).

Description of Reanalysis Sample

Since our case selection criteria reduced sample size substantially (from the grade 11 test sample of 7365 to stage 1 of 6,914 to stage 2 of 3155), we now present a description of the reanalysis sample in order to provide some indication of how application of the selection criteria may have changed the composition of the reanalysis sample. Since the severest reduction of sample size took place with application of the final selection criterion, we present data to compare characteristics of stage 1 sample (after application of the first three selection criteria) with those of our stage two or final reanalysis sample.

Table 3.2.6 describes the composition of the stage 1 and 2 samples, by sex and curriculum program. As this table shows, the overall sex distribution of these two samples is very similar. Note, however, that the distribution in terms of curriculum program was not so stable. Curriculum program enrollments by sex varied by as much as 20% between stage 1 and stage 2 samples. For example some 67-69% of males and females in the stage 2 sample were academic or college prep as compared with only 46-49% in the stage 1 sample. This means simply that consistency of grade 9 curriculum identification with that of grade 11 was more common among college prep students than among those who reported other curriculum programs at grade 11. Note, however, that apart from the college prep group, reductions in relative sizes of the other group were of similar size, that is with stage 2 groups being approximately 55-70% the size of the corresponding stage 1 groups. The most notable exception was the male business-commercial group reduced from 308 (or 9%) of males in stage 1 to 45 or 2.9% in stage 2. This simply means that the majority of males self-reported

TABLE 3.2.6: Growth Study Stage 1 and Stage 2 or Final Reanalysis Sample Composition by Sex and Curriculum Program

	Stage 1 Sample		Final Reanalysis Stage 2 Sample	
	Males (N=3423)	Females (N=3491)	Males (N=1542)	Females (N=1613)
General	20.0	14.4	11.9	8.2
Business-Commercial	9.0	30.7	2.9	19.8
Other Vocational	21.7	8.5	16.0	5.3
Academic	49.3	46.3	69.3	66.8
Total Sex	49.5	50.5	48.9	51.1

as business-commercial majors in grade 11 (or 12) were <u>not</u> so identified in grade 9.

To further explore the implications of sample restriction for our final reanalysis sample, we compared the stage 1 and 2 samples, by sex, race (black and predominently white) and curriculum group (general, business-commercial, other vocational and college prep) in terms of the following variables:

grade 7 STEP Reading Score
STEP Math Score
STEP Writing Score

grade 9 STEP Reading Score
STEP Math Score
STEP Writing Score

Mother's education (grade 11 or 9 report)
Father's education (grade 11 or 9 report)
Family press score (grade 11 or 9 report).

Rather than presenting data tables for each of these comparisons, let us simply describe overall findings from them. Blacks comprised a smaller proportion of the stage 2 sample, though differences across sex-curriculum subgroups were less than 5% with one exception (i.e., there were 5.5% less black females in the business group in the stage 2 sample than in the stage 1 sample). Comparison of averages on mother's and father's education indicated that stage 1 and 2 subgroups were fairly similar, and likewise the family press variable showed no notable differences (i.e., no differences between corresponding stage 1 and 2 subgroups of as much as one-half standard deviation). With respect to grade 7 and 9 test scores, there was a slight tendency for stage 2 subgroup scores to average slightly higher. However differences between corresponding subgroups rarely exceeded 4 standard scale points. In light of standard deviations in the range of 14-16 points, this means that the largest differences were on the order of one-quarter standard deviation.

In summary from our examination of background data on stage 1 and stage 2 subgroups, we conclude that while some differences were apparent, these tended to be fairly small (i.e., almost invariably less than one-half standard deviation). Moreover, the largest differences were apparent for those groups which had very small numbers of cases in the stage 2 sample (Black males in the business group n = 11, Black females in the other vocational group n = 13, and Black females in the general group n = 21. Because of such small sample sizes and their apparent effects on characteristics of such subgroups we do not report regression results separately for these subgroups.

Reanalyses

As with our treatment of Project TALENT data, we performed three types of analyses on the Growth Study Data Set, namely cross-tabular analyses, graphical analyses and regression reanalyses. Before describing these analyses and their results, three key limitations of all of these reanalyses should be reiterated. First, with respect to the timing of the test data examined, it should be emphasized that the data which we are treating as pre- and post-test data are drawn from tests administered in Sept-Oct of grades 9 and 11 respectively. Therefore the comparisons drawn pertain mainly to the first half of high school experience, rather than to the whole high school experience. Second, it should be recalled that with respect to racial identifications, we would have liked to treat race groups separately in reanalyses of Growth data, as we did in our larger study (see Woods and Haney, 1981). However, we were only able to approximate this goal. The category we call "white" or "predominantly white," for example, is comprised of both those directly identified as white and those for whom no racial identification is available. Also, the sample sizes for some subgroups of Blacks are too small in our opinion to allow for meaningful regression reanalyses (a sample size of 25 individuals per subgroup was our criterion in this regard). Third, although data on college preparatory or academic high school students are presented, it should be emphasized that the major comparison of interest is vocational program students with general program students because general and vocational students tend overall to be far more similar to one another than either group is to the college prep or academic group.* With these caveats in mind, what were the reanalyses we conducted on the Growth data set, and with what results?

Cross-Tabular Analyses. These analyses consisted simply of calculating the means and standard deviations of scores on the STEP reading, math and writing tests separately by sex-race-curriculum subgroup for both the grade 9 and grade 11 time points. These data were calculated for both the stage 1 and the stage 2 reanalysis samples. The stage 2 sample is simply a subset of the stage 1 sample for the two time points. Cross-tabular test results for the reanalysis samples, both stage 1 and 2, are shown separately by sex, race and curriculum subgroup in Tables 3.2.7 - 3.2.12. Specifically these six tables show the average STEP reading, math and writing scores, first for males and then for

* See Woods and Haney 1981 for a full discussion of why we give primary emphasis to the vocational-general comparison.

TABLE 3.2.7: Growth Study Reanalysis Sample, Stage 1 and 2, STEP Reading Score Means, Grade 9 and 11, and Mean Differences, Males By Race and Curriculum Subgroup.

	Grade 9 Means		Grade 11 Means		Grade 11-9 Difference 11-9	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
White Males						
General	270.6	271.2	281.3	281.9	10.7	10.7
Commercial	268.4	273.8	280.6	285.3	12.2	11.5
Other Voc.	269.5	269.8	280.8	282.1	11.3	12.3
Acad.	286.7	288.7	298.2	300.5	11.5	11.8
Black Males						
General	264.9	264.7	272.6	271.3	7.7	6.6
Commercial*	264.5	263.8	273.0	274.3	8.5	10.5
Other Voc.	261.7	261.2	273.6	272.5	11.9	11.3
Acad.	276.0	281.2	287.6	293.0	11.6	11.8

* Stage 2 sample size less than 25.

TABLE 3.2.8: Growth Study Reanalysis Sample, Stage 1 and 2, STEP Reading Score Means Grade 9-11, and Mean Differences, Females, By Race and Curriculum Subgroup.

	Grade 9 Means		Grade 11 Means		Grade 11-9 Difference 11-9	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
White Females						
General	279.3	278.3	288.8	288.2	9.5	9.9
Commercial	279.4	280.3	289.5	290.2	10.1	9.9
Other Voc.	276.3	276.0	285.6	283.1	9.3	7.1
Acad.	292.8	293.8	304.3	305.9	11.5	12.1
Black Females						
General*	266.2	270.8	273.9	279.5	7.7	8.7
Commercial	269.4	269.1	278.7	278.4	9.3	9.3
Other Voc.*	259.8	254.0	273.0	265.8	13.2	11.8
Acad.	281.2	283.2	290.3	293.3	9.1	10.1

* Stage 2 sample size less than 25.

TABLE 3.2.9: Growth Study, Reanalysis Sample. Stage 1 and 2, STEP Math Score Means, Grade 9 and 11, and Mean Differences, Males, By Race and Curriculum Subgroup.

	Grade 9 Means		Grade 11 Means		Grade 11-9 Difference	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
White Males						
General	263.8	264.6	271.3	271.5	7.5	6.9
Commercial	261.0	261.9	271.2	272.2	10.2	10.3
Other Voc.	264.4	266.1	270.8	274.1	6.4	8.0
Acad.	277.4	279.1	285.3	287.2	7.9	8.1
Black Males						
General	255.1	254.7	260.7	260.9	5.6	6.2
Commercial*	254.2	255.8	259.8	260.6	5.6	4.8
Other Voc.	256.9	256.2	261.9	260.0	3.1	3.8
Acad.	264.3	268.9	269.0	275.2	4.7	6.3

* Stage 2 sample size less than 25.

TABLE 3.2.10: Growth Study Reanalysis Sample, Stage 1 and 2, STEP Math Score Means, Grade 9 and 11, and Mean Differences, Females, By Race and Curriculum Subgroup.

	Grade 9 Means		Grade 11 Means		Grade 11-9 Difference	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
White Females						
General	263.9	262.5	267.8	268.4	3.9	5.9
Commercial	263.1	263.3	268.7	269.9	5.6	6.6
Other Voc.	261.0	261.7	265.3	266.2	4.3	4.5
Acad.	275.8	277.0	281.5	283.0	5.7	6.0
Black Females						
General*	250.2	253.6	253.9	256.7	3.7	3.1
Commercial	254.3	252.9	255.6	254.6	1.3	1.7
Other Voc.*	248.3	240.3	253.7	250.8	5.4	10.5
Acad.	262.6	264.2	264.4	266.4	1.8	2.2

* Stage 2 sample size less than 25.

TABLE 3.2.11: Growth Study Reanalysis Sample, Stage 1 and 2, STEP Writing Score Means, Grade 9 and 11, and Mean Differences, Males, By Race and Curriculum Subgroup.

	Grade 9 Means		Grade 11 Means		Grade 11-9 Difference	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
White Males						
General	264.4	265.2	273.5	272.7	9.1	7.5
Commercial	261.7	264.4	274.1	278.4	12.4	14.0
Other Voc.	264.8	265.8	274.3	275.3	9.5	9.5
Acad.	281.0	283.2	291.4	294.0	10.4	10.8
Black Males						
General	255.6	254.9	266.2	266.6	10.6	11.7
Commercial*	258.5	257.4	267.9	270.6	9.4	13.2
Other Voc.	256.8	255.1	268.2	267.9	11.4	12.8
Acad.	267.8	272.3	281.3	286.2	13.5	13.9

* Stage 2 sample size less than 25,

TABLE 3.2.12: Growth Study Reanalysis Sample, Stage 1 and 2, STEP Writing Means, Grade 9 and 11, and Mean Differences, Females, By Race and Curriculum Subgroups.

	Grade 9 Means		Grade 11 Means		Grade 11-9 Difference	
	Stage 1	Stage 2	Stage 1	Stage 2	Stage 1	Stage 2
White Females						
General	276.0	275.1	284.0	284.4	8.0	9.3
Commercial	275.6	276.4	284.1	284.2	8.5	7.8
Other Voc.	271.6	272.0	280.8	279.4	9.2	7.4
Acad.	290.9	292.2	301.2	303.0	10.3	10.8
Black Females						
General*	259.0	264.0	271.0	271.7	12.0	7.7
Commercial	263.0	263.9	274.6	271.6	11.6	7.7
Other Voc.*	257.2	255.1	272.2	267.2	15.0	12.1
Acad.	276.0	278.2	287.1	289.8	11.1	11.6

* Stage 2 sample size less than 25.

females, for grade 9 and grade 11, together with the average difference scores for each subgroup for both stage 1 and stage 2 samples.

Before commenting on the apparent differences between curriculum subgroups, let us first discuss differences apparent between stage 1 and stage 2 reanalyses samples. The stage 1 sample represents individuals who reported particular curricula at grade 9 and at grade 11, whether or not the grade 9 and 11 reports were the same. The stage 2 sample, however, consists of only those individuals who reported the same curriculum at grade 9 and 11. Table 3.2.13 presents the differences in test scores between the two samples by sex, race and curriculum subgroup for each of the three STEP tests at grade 9 and 11 and also for grade 9-11 gains (i.e. difference in the stage 1 and 2 change scores). As can be seen from this table, average scores for the two samples differed by as little as zero and as much as 8.0 standard score points (for the female Black other vocational subgroup in grade 9 math scores). The average absolute differences ranged from about 1.8 to 2.5 for the grade 9 and 11 averages, and were slightly lower for the sample differences in gain scores (i.e. 0.8, 1.0, and 1.6 for reading, math and writing). Note also that sample differences tended to be largest for subgroups with the smallest numbers of cases (e.g. the female Black other vocational subgroup with only 13 in the stage 2 sample). This fact illustrates our concern about the subgroups with sample sizes of less than 25, for which simple sampling variation can cause relatively large changes in average test scores. Nevertheless. the overall finding

TABLE 3.2.13: Stage 1-2 Sample Mean Differences (Stage 2 Minus Stage 1) STEP Reading, Math and Writing Subscores, By Sex, Race and Curriculum Subgroup.

	N		Reading			Math			Writing		
Male White	Stage 1	Stage 2	9	11	Gain	9	11	Gain	9	11	Gain
Gen.	561	148	0.6	0.6	0	0.8	0.2	-0.6	0.8	-0.8	-1.6
Comm.	233	33	5.4	4.7	-0.7	0.9	1.0	0.1	2.7	4.3	1.6
Other Voc.	638	219	0.3	1.3	1.0	1.7	3.3	1.6	1.0	1.0	0
Acad.	1,549	1,006	2.0	2.3	0.3	1.7	1.9	0.2	2.2	2.6	0.4
Male Black											
Gen.	123	35	-0.2	-1.3	-1.1	-0.4	0.2	0.6	-0.7	0.4	1.1
Comm.	75	11*	-0.7	1.3	2.0	1.6	0.8	-0.8	-1.1	2.7	3.8
Other Voc.	105	27*	-0.5	-1.7	-0.6	-0.7	-1.9	0.7	-1.7	-0.3	1.4
Acad.	139	63	5.2	5.4	0.2	4.6	6.2	1.6	4.3	4.9	0.4
Female White											
Gen.	408	111	-1.0	-0.6	0.4	-1.4	0.6	2.0	-0.9	0.4	1.3
Comm.	869	276	0.9	0.7	-0.2	0.2	1.2	1.0	0.8	0.1	-0.7
Other Voc.	251	72	-0.3	-2.5	-2.2	0.7	0.9	0.2	0.4	-1.4	-1.8
Acad.	1,427	975	1.0	1.6	0.6	1.2	1.5	0.3	1.3	1.8	0.5
Female Black											
Gen.	95	21*	4.6	5.6	1.0	3.4	2.8	-0.6	5.0	0.7	-4.3
Comm.	204	43	-0.3	-0.3	0	-1.4	-1.0	0.4	0.9	-3.0	-3.9
Other Voc.	47	13*	-5.8	-7.2	-1.4	-8.0	-2.9	5.1	-2.1	-5.0	-2.9
Acad.	190	102	2.0	3.0	1.0	1.6	2.0	0.4	2.2	2.7	0.5
	6,914	3,155									
Sum of Absolute Differences			30.8	39.5	12.7	30.3	28.4	16.2	28.1	32.7	26.2
Average Absolute Difference			1.9	2.5	0.8	1.9	1.8	1.0	1.8	2.0	1.6

Source: Derived from Tables 3.2.7-3.2.12.
*Stage 2 Sample n less than 25.

from Table 3.2.13 is that simple sampling variation between our stage 1 and stage 2 samples can lead to test score differences of as much as 4 or 5 standard scale points.

In comparison to these sample differences, subgroups show somewhat larger gains in test scores between grade 9 and grade 11, and average gains are of similar magnitude for stage 1 and stage 2 samples. Specifically out of 48 comparisons, only four cases showed differences in gain between stage 1 and 2 samples of 3.0 standard scale points or more and three out of four of these concerned instances alrea.y noted in which stage 2 subgroup samples had less than 25 cases.* Given the similarity of gain scores across stage 2 and stage 1 samples, the rest of this discussion will focus on stage 2 samples since these are the samples employed in regression analyses described below. Across the sixteen sex-race-curriculum subgroups average gain scores were 10.3 points in reading (or .63 standard deviation of the pooled grade 9 stage 2 sample scores), 5.9 points in math (or .42 SD) and 10.5 points (or .58 SD) in writing test scores. In other words, there appears to be a slight tendency for students to gain relatively less in math scores than in reading or writing, when gain scores are compared in terms of variations in the pooled sample of grade 9 scores.

With these general points in mind, let's return to the general question of interest, namely: how vocational student's test scores compare with those of general students. Relevant data, summarized from Tables 3.2.7-3.2.12 are shown in Table 3.2.14. Specifically this table shows the differences in test score

* 3.0 standard scale points is equivalent to .16 - .21 standard deviation of pooled grade 9 test scores depending on which STEP test is considered.

TABLE 3.2.14: Average Differences Between Test Scores of General Program Students and Other Curriculum Program Students, STEP Reading, Math and Writing, Grades 9 and 11, and Gains, By Sex and Race Group (Stage 2 Sample).

	Reading			Math			Writing		
Male-White	9	11	Gain	9	11	Gain	9	11	Gain
Comm.	2.6	3.4	0.8	-2.7	0.7	3.4	-0.8	5.7	6.5
Other Voc.	-1.4	0.2	1.6	1.5	2.6	1.1	0.6	2.6	2.0
Acad.	17.5*	18.6*	1.1	14.5*	15.7*	1.2	18.0*	21.3*	3.3
Male-Black									
Comm.**	-0.9	3.0	3.9	1.1	-0.3	-1.4	2.5	4.0	1.5
Other Voc.	-3.5	1.2	4.7	1.5	-0.9	-2.4	0.2	1.3	1.1
Acad.	16.5*	21.7*	5.2	14.2*	14.3*	0.1	17.4*	19.6*	2.2
Female-White									
Comm.	2.0	2.0	0	0.8	1.5	0.7	1.3	-0.2	-1.5
Other Voc.	-2.3	-5.1	-2.8	-0.8	-2.2	-1.4	-3.1	-5.0	-1.9
Acad.	15.5*	17.7*	2.2	14.5*	14.6*	0.1	17.1*	18.6*	1.5
Female-Black***									
Comm.	-1.7	-1.1	0.6	-0.7	-2.1	-1.4	-0.1	-0.1	0
Other Voc.**	-16.8*	-13.7*	3.1	-13.3*	-5.9	7.4	-8.9	-4.5	4.4
Acad.	12.4*	13.8*	1.4	10.6*	9.7*	0.9	14.2*	18.1*	3.9

Source: Derived from Tables 3.2.7-3.2.12, specifically other curriculum group averages minus general students' average.

* Asterisk indicates average difference which exceed one-half standard deviation of pooled grade 9 reading, math and writing scores (i.e. 8.13, 6.99, and 9.06 respectively).

** Stage 2 sample size less than 25.

*** Stage 2 sample size for female-Black general subgroup less than 25.

averages between general program students and other curriculum students, separately by sex and race group, at grade 9 and 11, and for gain scores as well, for STEP reading, math and writing tests. Perhaps most obvious in this table is that across all four sex-race groups, academic program students score higher than general program students at both grade 9 and 11. Specifically at both grade levels academic program students, on average, score ten to eighteen points higher, on all three tests than general program students; differences which are around one standard deviation of grade 9 scores in magnitude. In contrast, in the comparisons of primary interest in our study, vocational subgroup scores do not on average, differ markedly from those of general program students. Focusing first on grade 9 and grade 11 averages, we see that out of 48 comparisons between the two vocational groups and the general group (separately for the four sex-race subgroups, two grade levels and three tests), in only three cases do the vocational subgroups vary on average, by as much as one-half standard deviation of pooled grade 9 scores from the general program group averages. Moreover all of these cases are for the female-Black other vocational subgroup, the one for which as already noted considerable caution is necessary because of the small size of this subgroup sample. Turning next to gain scores, we see that there is even more similarity. Across all 36 comparisons in gain scores represented in Table 3.7.14, the average absolute difference between other curriculum groups and general program group gain scores is 2.2, or well within the range of error directly attributable to sampling vagaries. In only three cases do other curriculum groups show a gain of more than five points different than the respective general curriculum subgroup: Male-Blacks in the academic group gained 5.2 points more than male-Blacks in the general group; female-Blacks in the other-vocational group gained 7.4 more points than female-Blacks in the general groups; and male-whites in the commercial group gained 6.5 points more than the corresponding general group.*

Thus from these cross-tabular data we draw the following three conclusions. In terms of the data represented in our Growth Study reanalyses sample,

(1) across all four sex-race groups, academic program students score substantially higher on all three tests then general program students at both grade 9 and grade 11.

(2) vocational students, on average, score about the same as general students, at both grade 9 and 11, on the STEP reading writing and math STEP tests; and

(3) all three types of students, general, academic and vocational, on average, show similar gain scores in all three tests between grade 9 and 11.

Graphical Analyses. The cross-tabular analyses described above are of course quite crude. Average gain scores take the relationship between grade 9 and grade 11 scores into account in only a very primitive way. Therefore as a preliminary step toward the goal of regression analyses we carried out graphical analyses of the Growth Study test data. Specifically, we prepared scatterplots showing the relationship between corresponding test scores at grade 9 and grade 11 for each of sixteen sex-race curriculum subgroups. To save space, rather than presenting all 48 of these scatterplots, we simply summarize the correlations between corresponding grade 9 and 11 tests in Table 3.2.15 and discuss what our examination of the scatterplots revealed. Table 3.2.15 indicates that the correlations between grade 9 and 11 test scores generally fell in the .55-.80 range (specifically 33 or .69% of the 48 correlations shown). The median of the correlations shown is .66, meaning that on average, grade 9 test scores

* Again it should be noted that the female-Black other vocational subgroup had only 13 cases.

TABLE 3.2.15: Correlations Between Corresponding Grade 9 and 11 STEP Tests, By Sex, Race, Curriculum Subgroup (Stage 2 Sample).

	Correlations and Sample Sizes					
	Reading		Math		Writing	
Male-White	r	n	r	n	r	n
Gen.	.66	133	.62	138	.63	138
Comm.	.59	28	.54	31	.66	32
Other Voc.	.71	212	.57	215	.72	212
Acad.	.68	888	.72	893	.69	889
Male-Black						
Gen.	.58	34	.47	33	.68	34
Comm.*	.91	10	.40	11	.82	11
Other Voc.*	.34	26	.25	24	.20	24
Acad.	.80	61	.52	62	.70	61
Female-White						
Gen.	.76	105	.70	107	.74	107
Comm.	.65	266	.48	269	.65	264
Other Voc.	.69	68	.67	65	.67	67
Acad.	.69	841	.68	840	.68	837
Female-Black						
Gen.*	.65	19	.01	20	.62	20
Comm.	.66	39	.31	41	.53	39
Other Voc.*	.70	13	.21	12	.52	13
Acad.	.77	98	.60	96	.68	99

* Sample size less than 25.

explained about 44% of the variance in grade 11 test scores within the Stage 2 reanalysis sample sex-race-curriculum subgroups. Note, however, that the sex-race-curriculum subgroups with small numbers of cases (i.e. less than 25) account for a disproportionate number of extreme values of the correlations shown (specifically 9 of 15 instances outside the .55-.80 range). This pattern clearly serves to reemphasize the caveat already expressed about interpretation of results for subgroups having less than 25 cases.

In examining scatterplots of grade 9 and grade 11 test scores, we looked for two things. First, we sought to identify any outlying values, in the general curriculum subgroups, so that these could be deleted prior to using the general subgroups' test data to develop prediction equations to apply to the other curriculum program subgroups, as explained in the next section. Second, we examined histograms and scatterplots to identify any cases of ceiling or floor effect for either grade 9 or grade 11 test scores (that is cases in which test scores appeared not to be normally distributed, but instead to be bunched up toward either the higher or lower end of the scale). Among the 48 test score distributions examined there was some indication of ceiling effects on White grade 9 reading scores for the college prep group (male and female) and of floor effects on five grade 11 math distributions. However, in none of these cases were distributions skewed as greatly as the four distributions noted regarding Project TALENT test scores.

The visual inspection of test score distributions was carried out independently of (actually prior to) analysis of the grade 9-11 test correlations, but the seven cases accounted for four of the outlying correlation coefficients shown in Table 3.2.15 (specifically cases in which the grade 9-11 correlations were .47, .01, .31, and .21).

What else might be implied by such skewed test score distributions? First, referring back to the cross-tabular results presented in Tables 3.2.7-12 and 3.2.14, we noted that four of five instances of apparent floor effects involved Female Black curriculum subgroups, previously noted to be less trustworthy because of relatively small sample sizes. For these reasons (and particularly because prediction equations were developed on general program curriculum groups which for female Blacks had less than 25 cases), we do not present regression results for female Blacks in the next section. Second, note that slight ceiling effects were apparent for White academic students both male and female for grade 9 reading scores. This raises problems in interpreting regression results for these groups on reading scores, but recall that test scores of academic students are not a primary focus of concern in our inquiry.

Regression reanalyses. Having conducted cross-tabular and graphical analyses of the Growth Study reanalysis sample data, our next step, as with the TALENT data, was to conduct regression reanalyses. Specifically, we used data on general program grade 9 and 11 test scores (after deleting outliers) to develop regression equations for predicting grade 11 test scores. The prediction equations were developed separately by sex-race group, except that the female Black group was omitted from these analyses, because it contained so few cases (n = 19 or 20, depending on which test is considered) in the stage 2 sample. Thus, prediction equations were developed separately for the three sex-race groups of general students namely male-Whites, female-Whites, and female-Blacks. For each of these groups, separate prediction equations were developed for each of the three STEP tests, namely reading, math and writing. For each of these nine cases (three sex-race groups, and three tests each) the first prediction equation simply used the grade 9 test scores to predict the corresponding grade 11 test scores. Next, grade 11 test scores were predicted using both the corresponding grade 9 test score, and the "family press" (FP) score described above on p. 61. Thus a total of 18 separate prediction equations were developed, all based on data for general program students in our stage 2 sample. Table 3.2.16 shows the summary statistics for all eighteen prediction equations. Several points are worth noting about these results. First, the grade 9 test scores explain some 40 to 60% of the variance in corresponding grade 11 test scores (the exception is math scores for male Blacks, for which only 26 cases were available). Second, addition of FP scores to the prediction equations explains very little variance in grade 11 scores above and beyond that explained by grade 9 scores. This corresponds with what we found in TALENT regression reanalyses (namely that SES and school variables added little predictive power beyond that afforded by grade 9 scores, see pp. 44-45). Third, White females' grade 11 scores were predicted with greater precision (i.e. higher R^2) than White males' scores, again paralleling what we found with TALENT data. Fourth, grade 11 reading scores were predicted with more precision than grade 11 math scores (again what we found in the Project TALENT data), but for the two male groups grade 11 writing scores showed higher R^2 than grade 11 reading scores. Comparisons between Growth results and TALENT results need to be viewed with some caution, however, for two reasons. First, the intervals spanned by the

TABLE 3.2.16: Summary Statistics for Growth Study Prediction Equations, Developed Using Data on General Program Students

Test Score Predicted and Prediction Variables	Males-Whites					Females-Whites					Males-Blacks				
	N	Cnst.*	b*(gd 9 test)	R	R^2	N	Cnst.*	b*(gd 9 test)	R	R^2	N	Cnst.*	b*(gd 9 test)	R	R^2
Reading Gd 11															
Equation 1: Gd 9 Reading	125	93.90	0.69	.697	.486	94	61.67	0.82	.814	.603	33	61.37	0.80	.628	.394
Equation 2: Gd 9 Reading & FP	121		0.70	.700	.489	93		0.79	.808	.693	33		0.79	.632	.400
Math Gd 11															
Equation 1: Gd 9 Math	125	67.65	0.78	.694	.482	93	75.09	0.74	.780	.608	26	170.85	0.37	.434	.188
Equation 2: Gd 9 Math & FP	121		0.77	.706	.499	93		0.72	.785	.616	26		0.35	.440	.194
Writing Gd 11															
Equation 1: Gd 9 Writing	132	85.02	0.70	.713	.509	98	61.37	0.81	.790	.624	31	71.08	0.77	.684	.468
Equation 2: Gd 9 Writing & FP	127		0.73	.728	.531	98		0.81	.790	.624	31		0.78	.689	.475

[Note: Equations not developed for female Blacks because of small number of cases]

* Standard score metric.

two sets of data are different: TALENT from March-April of grade 9 to March-April of grade 12 or about 36 months, and Growth from Sept-Oct grade 9 to Sept-Oct grade 11 or about 24 months. Second, the STEP reading and mathematics tests are designed to tap a broader range of skills than the TALENT reading comprehension and arithmetic computations/reasoning tests respectively.

As with the TALENT regression reanalyses, the prediction equations developed using data on general program students in the Growth reanalysis (stage 2) data set, were next applied to data for commercial, other vocational and academic or college preparatory students, separately by sex-race group, to produce predicted grade 11 scores. Predicted grade 11 scores were then subtracted from actual grade 11 scores to produce residuals showing how much more or less the commercial, other vocational, and academic students tended to score on grade 11 tests than was predicted on the basis of performance of general program students. Residuals were calculated in two forms: in terms of the STEP standard scores and in terms of Z scores (the standard scale score residual divided by the appropriate standard deviation).

Results are shown in Table 3.2.16. The first noteworthy finding is that results from our first and second prediction equations differ very little. In other words, adding the FP scores to prediction based on grade 9 test scores changed results very little. This is of course not terribly surprising given that FP added very little to the prediction equations developed on the data for general program students. Second, only 19 out of 48 Z-score residuals were 0.50 or greater. Thirteen of these were for college preparatory groups. For Whites, both males and females, college prep students scored higher than predicted on the basis of general program students' performance on both reading

TABLE 3.2.16: Average Residuals for Grade 11 Test Scores. By Curriculum Program. Sex-Race Group. and Type of Prediction Equation Used.*

Standard score residual. Z - score residual, and sample size

	White Males			White Females		
Reading	Comm.	Other Voc.	Coll.Prep.	Comm.	Other Voc.	Acad.
Equation 1	1.53	1.29	6.25	-0.17	-4.41	4.30
	0.14	0.12	0.58*	-0.02	-0.52*	0.51*
	28	212	890	267	69	841
Equation 2	1.70	1.34	6.05	-0.24	-4.99	4.15
	0.16	0.12	0.55*	-0.03	-0.60*	0.50*
	28	195	878	263	66	829
Math						
Equation 1	0.24	-0.42	2.42	0.09	-2.86	2.89
	0.03	-0.05	0.29	0.01	-0.41	0.41
	31	215	895	270	66	840
Equation 2	0.43	0.24	3.50	0.14	-2.49	2.31
	0.05	0.03	0.42	0.02	-0.36	0.33
	30	198	883	267	64	828
Writing						
Equation 1	6.16	2.83	8.65	-1.01	-2.99	4.74
	0.61*	0.28	0.86*	-0.10	-0.31	0.49
	32	2.2	891	265	68	837
Equation 2	6.01	2.54	7.16	-0.94	-2.31	4.85
	0.61*	0.26	0.72*	-0.10	-0.24	0.50*
	31	195	879	262	66	826

	Black Males	
Reading	Other Voc.	Coll. Prep.
Equation 1	2.03	7.56
	0.16	0.61*
	27	61
Equation 2	1.69	8.34
	0.13	0.66*
	24	57
Math		
Equation 1	-7.92	4.64
	-0.98*	0.57*
	26	62
Equation 2	-7.13	4.91
	-0.87*	0.60*
	24	58
Writing		
Equation 1	0.31	6.76
	0.04	0.79*
	26	61
Equation 2	0.01	6.95
	0.00	0.81*
	25	57

* Z-score residuals of 0.50 or greater are marked with an asterisk. Sample sizes within sex-curriculum test score group vary because of missing data. Data for all female Black groups and for the Black male commercial group are omitted due to small sample sizes.

and writing tests, and Black Males scored higher than predicted on all three tests. These results may be partially explained by the ceiling effects on grade 9 reading scores for both the male and female White college prep groups.

It is worth commenting, at least briefly, on why these regression results (Table 3.2.16) for academic groups appear quite different than the gain score results (Table 3.2.14). In both cases, changes in academic groups scores between grade 9 and 12 were compared with those for corresponding groups of general program students. Yet the average gain score differences showed changes to be quite similar for academic and general groups, while the residuals suggest that most of the academic subgroups gained more than predicted on the basis of general groups' patterns of performance. We did not explore these contrasting findings in any detail because performance of academic program students was not a primary focus of our study. Nevertheless, the most obvious explanation seems to us to be the following. Although average gains in test scores of academic and general groups were highly similar, it should be recalled that at both grade 9 and grade 11, the academic groups' scores were on average one standard deviation above the scores of the corresponding general groups on all three tests. Given such differences at the two time points, extrapolating the performance of one group to predict that of the other is somewhat hazardous. Hence, the academic groups' residuals should not be taken at face value without further investigation of background factors which might explain both grade 9 score differences and grade 9-11 changes as well.

Turning to the comparisons of primary interest for our study, namely the vocational groups with general groups, we see that far fewer of the Z-score residuals were 0.50 or greater. Specifically, out of 30 Z-score residuals shown for vocational groups, only six were equal to or greater than 0.50. These were for the following groups and tests:

White males in the commercial group had writing scores about 6 standard score points greater than predicted.

Black males in the other vocational group had math scores 7-8 points lower than predicted.

White females in the other vocational group had reading scores which were 4-5 points lower than predicted.

It should be noted, however, that for two of these three groups caution should be exercised with respect to interpretation, because of small sample sizes. Specifically the White male commercial group had only 31 or 32 cases (depending on which prediction is considered) and the Black male other vocational group had only 24 or 26 cases.

Also, it is noteworthy that results for 12 of the vocational groups' outcomes (across the three types of tests) indicate actual grade 11 test scores varied little from what was predicted on the basis of general program students' test scores. Specifically,

For whites, male and female, in both the commercial and other vocational groups, math scores varied less than 3 points from what was predicted (though there appears to be a slight tendency for commercial groups to show higher gains than other vocational groups).

White males in both commercial and other vocational scored less than 2 points different than predicted on the STEP reading test.

White females in the commercial group scored less than 0.5 points different than predicted in reading.

White males in the other vocational group and white females in both commercial and other vocational groups scored less than 3 points different than predicted in writing.

Black males in the other vocational group scored only 2 points different than predicted in both reading and writing.

Comparing these differences to differences in scores between the stage 1 and stage 2 samples, it is reasonable to conclude that residuals of these magnitudes might easily result from vagaries of sampling.

These are the specific results from our regression reanalyses of the Growth Study reanalyses sample. What we make of these results more generally will be discussed in the next chapter, after we summarize the goals and methods used in our overall study.

IV. SUMMARY AND CONCLUSIONS REGARDING BASIC SKILLS ATTAINMENT

In this chapter, we briefly recount portions of this report before summarizing in section 4.4 our conclusions concerning the relationship between vocational education and basic skill attainment.

4.1 Background, Purpose and Scope

Amidst growing worries over basic skills achievement of our nation's students generally, specific concerns have been expressed over the basic skills attainments of vocational education students. The purpose of this report therefore has been to examine available evidence on the basic skills attainments of students enrolled in secondary vocational education programs. Before doing so, we also briefly review selected evidence on the basic skills requirements of occupations. Though basic skills learning of postsecondary vocational students is a question of potential interest, it should be noted that this report focuses on the secondary level. We use the term basic skills to refer to the traditional three R's of schooling, namely, reading, writing and arithmetic or mathematics. Even though we focus on only these three general skills, available tests provide only imperfect measures of these skills.

4.2 Basic Skills Requirements of Jobs

In past research a wide variety of methods have been used to identify the basic skills requirements for the sort of jobs for which secondary vocational education seeks to prepare students. These methods have included analyses of job descriptions, self-reports by people holding various jobs, analyses of written materials used on the job, and observations of people actually performing jobs.

Probably the most widely used source of information on the skill requirements of jobs is the Department of Labor's Supplements to the <u>Dictionary</u>

of Occupational Titles. These provide estimates of the physical demands, working conditions and training requirements for each of more than 10,000 occupational titles listed in the Dictionary. Skill requirements of occupations are divided into two broad categories: General Educational Development (GED) and Specific Vocational Preparation (SVP). The former encompasses the skills of reasoning, mathematics and language. For each of these skills, requirements were estimated by trained raters using task statements implicit in the Dictionary.

Several limitations of the DOT ratings are apparent for our purposes. Sticht (1979) criticized them as providing "only the coarsest differentiations of literacy requirements of jobs." Fine (1968) has pointed out that it is important to distinguish between "functional or performance requirements" of jobs and "employer or hiring" requirements. The latter may reflect labor market conditions and thus may or may not be closely related to functional or actual performance requirements. This distinction, together with the conclusion reached by Rumberger (1979) that the skill requirements of jobs have changed little over the past decade and a half, even though general educational levels of American workers have been increasing, suggest that hiring or employer requirements concerning basic skills may be more important for job-seekers than are strictly functional job requirements for basic skills.

A variety of other research has also been carried out over the last decade concerning the basic skills requirements of jobs; including analyses of literacy requirements, so-called generic skills requirements (communications, mathematics, science and reasoning) and necessary speaking and listening skills as well.

A range of skills thus seem to be viewed as necessary for a broad range of occupations. Among the research literature reviewed, reading is the skill most commonly investigated. However, even for this one general skill a range of methods have been used to investigate skill requirements of jobs. Moreover, even when common methods have been employed (e.g. readability analyses of materials read on the job) findings seem to vary substantially. One study, for example, estimated that "college to college graduate" level reading skills are required for secretarial jobs, while another study found that "professional, technical and managerial" personnel need reading skills of only around the eleventh grade in readability level. Such apparent discrepancies lead us to conclude that while a range of basic or generic skills seem to be quite important for a wide range of occupations, it appears that determining what levels of such skills are functionally required for specific jobs may be an impossible task. We reach this conclusion not only because of limitations evident in previous efforts to estimate functional requirements of jobs, but also because it is clear that requirements may change in light of both changing labor market conditions, and changing technology available to particular occupations. Yet even if we cannot determine the basic skills necessary for jobs for which secondary vocational education seeks to prepare students, it is still relevant to inquire into the question of how well vocational education prepares students with basic skills commensurate with those of others with whom vocational education graduates might compete for jobs. As Thurow (1979) has suggested, in a competitive job market with more workers available than jobs for them, the key issue is not absolute standards of literacy or basic skills but instead how the skills of vocational graduates compare with those of graduates from other curriculum programs.

4.3 Basic Skills Attainment of Secondary Vocational Students

We thus sought to address the question of how basic skills attainments of secondary vocational students compare with those of secondary general students. Specifically, we sought to compare attainments at entry into the different secondary curriculum programs, at time of graduation from them, and also gains in basic skills while in the programs. Though little good evidence is available with which to address these questions, we identified two national data sets with potential for answering these questions, namely

- Project TALENT 1963 Retest Sample
- Intellectual Growth and Vocational Development Study, cohort which graduated from high school in 1969.

Our reanalyses focus on these two data sets which, though somewhat old, seemed to offer the greatest potential of any data available at the time of our study for comparing the basic skills attainments of national samples of secondary general and secondary vocational students.

4.3.1 Project TALENT Retest Data and Reanalyses

Project TALENT was a nationally representative longitudinal study of students enrolled in grades 9 through 12 in 1960. In 1963, twelfth graders in 118 public high schools included in the 1960 survey were retested, and our TALENT reanalyses focused on this 1963 retest sample, which included over 7,000 cases of students who had been tested in both 1960 as ninth graders and 1963 as twelfth graders.

Our reanalyses of the TALENT retest sample drew on three types of data: curriculum self-reports, test data, and background information. In both 1960 and in a 1964 follow-up survey respondents were asked to identify their planned or actual high school program as general, college preparatory, commercial or business, vocational, agriculture, or other. Since there were discrepancies in curriculum identifications for some individuals across these two survey points, and because of other considerations, we focused our reanalyses mainly on individuals whose curriculum self-reports were consistent across these two points. The test data we used were the TALENT tests of reading comprehension, arithmetic reasoning, and arithmetic computations. Also used were data on individual's socioeconomic status, parent's education, and characteristics of the schools attended.

Four criteria were used in selecting cases from the TALENT retest sample for our reanalyses. Specifically cases included in our reanalyses had to have

- information on end-of-high school curriculum program
- matched reading comprehension or arithmetic test data for grades nine and twelve (that is pre- and post-test data on reading or on arithmetic)
- racial identification as white or attendance at a school whose principal identified it as having a racial composition of less than 20% Black (it was necessary to limit the reanalyses in this way to a "mostly White" sample because individual racial identification is available for less than half the retest file cases)
- grade 9 curriculum identification the same as the grade 12 identification.

Application of these four selection criteria reduced the number of cases from about 7,500 to 3,808. Since the reanalysis sample was so much reduced in size from the original TALENT retest sample, we examined the way in which our selection criteria might have changed the composition of the reanalysis sample from that represented in the original TALENT sample. Examining data on sex, curriculum program, SES and test scores, we found that college preparatory students represented a slightly larger proportion (6-7% larger) of the reanalysis sample than of the more general TALENT retest sample, and that one group of females showed a relatively large change in average test scores after application of our final selection criterion. Because of the latter finding this group was deleted from reanalyses. Otherwise, the reanalysis sample seemed similar to the larger sample in terms of SES, and test scores at both grade 9 and 12.

As a result of these considerations reanalyses were performed separately on seven sex-curriculum groups, namely

male - general
commercial
other vocational
college prep

female - general
commercial
college prep

The other vocational category was composed of cases identified in the TALENT data as vocational or agriculture. Pooling across these categories was necessary for males because of small sample sizes. The other vocational group was deleted for females however both because of small size (n for vocational and agriculture equaled only 28) and because average test scores of the female other vocational group in the final reanalyses sample differed notably (i.e. by more than 1/2 standard deviation) from those of the female other vocational group in the larger TALENT sample.

Three types of analyses were conducted on the TALENT data: cross-tabular analyses, graphical alanyses and regression analyses. Cross-tabular analyses indicated that at both grade 9 and grade 12, average test score differences between vocational groups (i.e. commercial, for both males and females and other vocational for males) differed relatively little from the average test scores of corresponding general curriculum program groups. However, on average, college preparatory groups scored one-half to one standard deviation greater than general students at both grade 9 and grade 12 (with differences tending to be larger on arithmetic reasoning and reading comprehension than on arithmetic computations). In contrast to these differences, cross-tabular results indicated that average gains between grade 9 and grade 12 were similar across all of the curriculum groups. Specifically, gain score differences across curriculum groups varied by less than one-third of a standard deviation of grade 12 test scores (except for comparisons with low numbers of cases which made any associated gains suspect).

Examination of graphs of test scores for the TALENT reanalysis sample showed an upward shift in grade 12 test scores in comparison to grade 9 test scores across all sex-curriculum groups. Also, however, it revealed that grade 12 reading comprehension and arithmetic reasoning test scores for both male and female college prep students were not normally distributed but instead tend to bunch toward the higher end of the scale, indicating that many grade 12 college prep students marked most items on these tests correctly (or what is sometimes called ceiling effects). Scattergrams of grade 9 vs. grade 12 test scores also revealed a number of outlying cases, which were omitted for the purposes of developing prediction equations (since small numbers of outliers can bias regression results).

Regression analyses were employed to develop prediction equations based on patterns of grade 9 and 12 test scores of general program students. These prediction equations were then applied to the data on other curriculum program students (i.e. commercial, other vocational, and college prep for males, and commercial and college prep for females), to show how they would score at grade 12 if their rates of attainment had been the same as that of corresponding general program groups. Three different prediction equations were employed (using only grade 9 scores; grade 9 scores and SES; and then grade 9 scores, SES and data on schools). Predicted scores were then subtracted from actual grade 12 scores to produce residuals which showed how much more or less other curriculum program students scored than predicted on the basis of performance of general program students. Results indicated that almost all residuals were less than one half of one standard deviation of grade 12 scores. Though results for the college prep group must be viewed cautiously because of apparent ceiling effects on two of thegrade 12 tests, these results lead us to conclude that evidence in the TALENT reanalysis sample indicates that among White female and male commercial students and male other vocational students gained about the same as general students in basic skills, as represented in TALENT reading comprehension, arithmetic reasoning and arithmetic computations tests.

4.3.2 Growth Study Data and Reanalyses

The Study of Academic Prediction and Growth was based on a sample of 27 schools across the nation, though it was not a strictly representative national sample as was the original TALENT sample. Our reanalyses of Growth data focused on the fourth cohort of students who were in ninth grade in fall 1965 and in grade 11 in fall 1967. These students were administered the Sequential Tests of Educational Progress in fall of grade 9 (Form 3A) and in fall of grade 12 (Form 2B). Our reanalyses focused on the STEP tests of reading, mathematics and writing.

Our selection of a Growth reanalysis sample was based on criteria roughly comparable to those employed in the TALENT reanalyses. Specifically cases included in our Growth reanalysis sample had to have:

- STEP test data for grade 11
- curriculum identification for grade 11 or 12
- race classified as white, black or unclassified (about 60% of Growth cohort 4 were unclassified as to race, so it was necessary to pool the unclassified cases with white cases to form a "predominantly White" category so as to retain a sufficient number of cases to allow analysis
- grade 9 curriculum identification consistent with that for grade 11 or 12.

Application of these selection criteria reduced sample size substantially (specifically of the 7,365 cases with grade 11 data, only 3,155 met the other three criteria). Thus we examined descriptive data on our final reanalysis sample in comparison to data on a larger Growth Study sample in an effort to determine how application of our selection criteria might have affected the composition of the Growth reanalysis sample. We found that application of the criterion of the grade 9 curriculum identification to be the same as grade 11, increased the proportion of college prep students from around 46-49% to 67-69%. Changes in proportions of the other curriculum groups (general, business-commercial, and other vocational) represented in the final analysis sample tended to be fairly similar. Also examined were data on parents' education, grade 7, 9 and 11 test scores and a "family press" variable. In sum, we concluded that differences in background characteristics between our final Growth Study reanalysis sample and the larger Growth sample tended to be fairly small, except for three sex-race-curriculum subgroups represented in the final sample by small numbers of cases (i.e. less than 25). For this reason these groups (Black females in general and other vocational groups, and Black males in the commercial group) were deleted from reanalyses.

As with the TALENT data set three types of analyses were performed on the Growth data. First were cross-tabular analyses, consisting simply of calculating means and standard deviations of all three types of STEP test scores for both grade 9 and 11. These were calculated for both our final reanalysis sample (total n = 5155) and for the larger sample (n = 6914) which existed prior to application of our final selection criterion (i.e. those cases with grade 9 curriculum identification the same as grade 11 or 12). Results indicated that application of our final selection criterion changed average subgroup test scores by as much as 3.0 points, but tended to change grade 9-11 gain scores by somewhat less. For our final reanalysis sample, average gains between grade 9 and 11, pooled across the sixteen sex-race-curriculum groups examined were 10.3 standard scale points in reading, 5.9 points in math, and 10.5 points in writing.

Turning to comparisons between curriculum groups, we found that across all four sex-race groups, college prep averaged substantially higher on all three tests than general program students at both grade 9 and 11, with differences of about one standard deviation of grade 9 scores in magnitude. In contrast, vocational subgroups' average scores did not differ markedly from those of general program students (except primarily for subgroups already noted having small sample sizes). Average gain scores differed even less across all types of curriculum groups, with notable differences again apparent only for Black subgroups having small numbers of cases.

Out next step was to examine graphs of grade 9 and 11 test scores. As with the TALENT data, this was done both to identify abnormal test score distributions and so as to delete outlying cases in the various general program subgroups, prior to development of prediction equations.

Prediction equations were developed on the male-White, male-Black and female-White samples of general students (the female-Black group was omitted due to small sample size) and these prediction equations were then applied to corresponding commercial, other vocational and academic groups (except for the male Black commercial group which had too few cases). Two different types of prediction equations were employed, one predicting grade 11 test scores only with corresponding grade 9 test scores and the other using both grade 9 test scores and the family press variable. Predicted grade 11 scores were than subtracted from actual grade 11 scores to produce residuals. Results indicated that for White males and females college prep students scored higher than predicted on the basis of general program student's performance on both reading and writing tests, and Black males college prep students scored higher than predicted on all three tests. In all of these cases residuals were more than one-half standard deviation. Another way to interpret these findings is to compare the residuals with the average gains of the corresponding general groups.* Doing so indicates that the college prep residuals, indicating how much more college prep students gained than predicted on the basis of general students' scores, amount to some 40 to 100% of the average general students' grade 9 to 11 gains. However, as explained previously, these results need to be viewed cautiously because the grade 9 score averages of general and academic groups differed by as much as a full standard deviation or more.

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*·Compare Table 3.2.16 with Tables 3.2.7-3.2.12.

Far fewer of the residuals for vocational subgroups were as large (specifically only six of 30 were as large as 0.50 standard deviations). Moreover, most of the large residuals for vocational groups were for ones (i.e. the Black male other vocational and White male commercial groups) which had relatively small sample sizes. Otherwise the only vocational group residual exceeding 0.50 standard deviations was for white males in the commercial group who scored about six points higher than predicted on the STEP writing test. For all other vocational group comparisons (12 groups and 24 comparisons based on the two types of prediction equations), in only one case was a residual as great as 0.40 standard deviations. From these results we conclude that evidence available in the Growth Study indicates that between fall of grade 9 and fall of grade 11, vocational program students' gains in basic skills as measured in the STEP reading, math and writing tests were not substantially different than gains of general program students.

4.4 Conclusions

Evidence reviewed in Chapter 2 substantiates the common belief that the basic skills of reading, writing and mathematics are important for a wide range of occupations. However, unlike some other investigators we conclude that it is, practically speaking, impossible to determine empirically the exact levels of basic skills which are functionally required for specific occupations. We reached this conclusion for three broad sets of reasons. First is the problem of methodology. There appears to us to be no clearcut and reliable method for assessing various basic skills requirements of jobs. Second, it is clear that functional requirements of specific jobs can change over time with changes in technology. Third, it is extremely hard to distinguish between actual performance or functional requirements of jobs. and requirements which are the products of a competitive marketplace. If many skilled applicants are available, employers naturally may hire ones with greater skills even if those skills are not actually, functionally required for the work they will be doing.

Nevertheless, the question of the basic skills attainments of vocational students is still an important one. Even if we cannot determine precise levels of basic skills necessary for jobs for which vocational education seeks to prepare students, it is clear that skills in reading and writing are required for a wide variety of such jobs. In a competitive job market, it is relevant, as Thurow pointed out, to inquire into the comparative question of how vocational students' basic skills attainments compare with those of students in other curricula, with whom they may have to compete for jobs. In this light, we used the TALENT and Growth Study data to compare the basic skills attainment of secondary vocational students with those of general program students.

Before stating the overall conclusions drawn from this investigation, let us first point out six important limitations of these data sets, for the pur poses to which we have put them. First is the vintage of the data we have re-analyzed. The TALENT retest file contains data gathered in the period 1960-63, and the Growth data we analyzed were gathered in the 1965-67 period. These data thus obviously are not directly pertinent to any examination of the basic skills attainment of vocational students now enrolled in the nation's schools. Second, the grade spans covered by the TALENT and Growth data are not ideal. TALENT data are available for the span of March-April grade 9 to March-April grade 12. Growth data cover the period Sept-Oct grade 9 to Sept-Oct grade 11. Since most secondary vocational programs aimed at preparing students for occupations (i.e. occupational as opposed to nonoccupational vocational education) are offered in grades 10, 11 and 12, we would have preferred data spanning these grade levels.

Third, means of curriculum identification available in these two data sets were limited. Student self-reports were the only source available for identifying students programs, and so these had to be used. Nevertheless, it should be noted that in our previous study (Woods & Haney 1981) we found that estimates of employment outcomes associated with participation in vocational education differed depending on whether curricula were identified on the basis of student self-reports or on the basis of course transcript information. Also, samples sizes were such as to allow only the broadest sort of differentiation among different types of secondary vocational education, namely between business or commercial and other vocational programs, and not even both of these distinctions could be drawn for some subgroups because of small sample sizes. Lack of greater differentiation is an important drawback because we know from previous work that outcomes may vary as much between different types of secondary vocational programs as between vocational and general programs. In part because of the problem of unreliability in self-reports of curriculum program we adopted the strategy of basing most curriculum comparisons on groups of individuals who gave consistent reports on the curriculum program enrollment at early and later survey points (grade 9 and 11 or 12 for Growth data, and grade 9 and 12 or one-year follow-up for TALENT data). This strategy was adopted also because, even aside from the problem of unreliability, when different curricula were reported at two time points, we had no way of knowing when a program transfer might have occurred. Thus our analyses largely do not take into account cases in which students reported different curricula at the early and later reporting dates.

Fourth, data for identifying the race of cases represented in the two data sets were highly imcomplete. We would have liked to keep analyses of different race groups (or at least White and Black) separate because, however regrettable, it is clearly true that individuals of different races often receive different treatment in our nation's schools. Also, it is well-known that test scores often differ substantially by race. However, individual racial data are highly incomplete in both of the data sets reanalyzed. Therefore we were forced to adopt the strategy of basing most of our analyses on groups which were predominantly White -- that is for TALENT, identified as White or who attended schools reported to be less than 20% Black, and for Growth individuals classified as White or unclassified (that is not classified as Black or some other racial group). To as great an extent as reasonable given available sample sizes we examined results separately for Blacks with Growth data, but in several instances, analyses for Blacks were not carried out because of small sample sizes.

Fifth, tests available in the two data sets are not ideal measures of the basic skills of reading, writing and math. Indeed no measure of writing skills at all is available in the TALENT data set, and the STEP writing test has been criticized as being based solely on multiple choice items and not employing actual writing samples (though it is worth noting that a STEP essay writing test is available). Nevertheless, whatever the weaknesses in general of standardized multiple choice tests as measures of basic skills, the TALENT tests and the STEP tests are certainly no worse than the genre, and in the opinion of reviewers cited perhaps better than most tests of this type.

Sixth, the data analyzed are strictly nonexperimental, that is they are not based on any experimental manipulation of things, for example, random assignments of students to different curriculum programs. This means that although we can compare grade 11 and grade 12 test scores of students in different curriculum programs, we can never be sure whether or not apparent differences are due to the programs in which students enrolled, or to pre-existing differences in the students who enter into different programs. To some extent we can control for preexisting differences; for example, by treating sex-race groups separately, by calculating gain scores and by doing regression analyses that include some measures of background characteristics. But with such non-experimental data, we can never be sure to what extent end of program differences are actually due to programs in which students enrolled and to what extent they are due to unmeasured differences in the character-istics of students who entered into different programs. For this reason we have slanted this study heavily toward description and have avoided the sort of causal inferences implied in phrases such as the effects of programs on basic skills test scores.

So given these six broad limitations what do we make of our findings? Broadly our conclusions, reviewed already in the foregoing sections of Chapter 4, are these. First, comparing test results for predominantly White samples of TALENT and Growth Study students, we conclude that on grade 9 and grade 11 or 12 tests of reading, math and writing (Growth Study only), scores were roughly equivalent for secondary vocational and general students. Second, by examining changes in test scores, in terms of both average gains and residuals of regression analyses, we conclude that test score gains of commercial program students and other vocational students, both male and female in our predominantly White samples, were not notably different than gains evidenced for general program students. Results for Black students in the Growth Study were far less clear, but where sample sizes were sufficient to allow reasonable comparisons for Black males, we found that the same general pattern seemed to hold, namely a rough equivalence in test scores in grade 9, grade 11, and gains in the interval, between general program and vocational program students.

Given the large limitations already noted regarding our reanalyses these general conclusions may not, at first glance, seem to amount to much. However, given recent concerns over the basic skills attainments of secondary vocational students, and specifically whether they attain basic skills commensurate with those of general program students with whom they may have to compete in the job market, these findings of no notable differences are certainly noteworthy. They may be especially so in light of the assertions of some critics that secondary vocational education constitutes a dead-end of educational opportunities, serving to track lower class and underpriviledged students into lower status programs where they learn less. This may be so in some cases perhaps. But our examination of data from two data sets from the 1960s, both national in scope, though not strictly nationally representative, provides no support for the proposition that the basic skills learning of secondary vocational program students is any less than that of general program students.

V. BASIC SKILLS ATTAINMENT AND EMPLOYMENT OUTCOMES ASSOCIATED WITH PARTICIPATION IN SECONDARY VOCATIONAL EDUCATION

In the last three chapters we have explored the relationship between participation in secondary vocational education and basic skills attainment as indicated by test scores. In this section we turn to examine the broader relationship between participation in secondary vocational education, basic skills attainment and employment outcomes. In section 5.1, we first provide a brief summary of what was learned in our previous study about the relationship between secondary vocational participation and employment outcomes. Then in section 5.2 we address the question of whether basic skills attainment in general appears to increase employment opportunities. Finally, in section 5.3 we address the question of whether basic skills attainment appears to enhance the employment opportunities of secondary vocational students in particular.

At the outset, however, we should explain that there presently exists no very good data set with which to address these questions. In our previous study we found that the NLS-72 data set was far and away the best available data with which to address the question of whether secondary vocational education, as compared with general education, seems to make a difference in employment outcomes. Yet NLS-72 provides no basis whatever for examining changes in test scores over the high school years, since NLS-72 base year data were acquired on high school seniors. Thus, in answering our questions about the interrelationships between secondary vocational education, basic skills attainment and employment outcomes, we must piece together available evidence from different sources.*

* It is worth noting that in the future, the High School and Beyond data set will afford greater potential for addressing these interrelated questions. In its base year of 1980, the High School and Beyond Study surveyed high school sophomores as well as seniors, who are to be followed up in future years.

5.1 Does Secondary Vocational Education Make a Difference in Employment Outcomes?

In our previous and larger study of vocational education (Woods and Haney, 1981), we surveyed a variety of evidence in order to assess the question of whether or not participation in secondary vocational education is associated with any gainful employment advantages. Without describing our methods of inquiry, nor the sources of evidence relied upon, let us here simply recap our general findings concerning employment outcomes associated with secondary vocational education.

Our first, and perhaps most important, conclusion regarding the question of whether secondary vocational education makes a difference in employment outcomes was that there is no one answer, for the simple reason that different evidence, pertaining to secondary vocational education for males and females and particularly to different vocational specialties often seems to point in different directions. We found, for example, at the secondary level that patterns of courses taken by vocational and general program students appear to be much more similar when vocational education is treated as an aggregate category than when major vocational specialties are treated separately.

Our second answer to the question "Does vocational education make a difference?" was a qualified yes. Evidence indicated that some forms of vocational education for some types of students, are associated with a variety of gainful employment advantages. Such advantages were most widely apparent in evidence concerning females, both white and black who graduated from high school commercial business programs and did not go on for post-secondary education. For this group, participation in vocational education whether identified in terms of self-reports or in terms of high school coursework in business and commercial areas, appears to significantly enhance employment opportunities for as long as four years after high school graduation, as indicated by the socioeconomic status of jobs held by graduates, the number of weeks worked per year, and weekly earnings. These advantages appear to be closely associated with the fact that female graduates of high school business-commercial programs frequently enter clerical jobs.

Evidence concerning gainful employment outcomes associated with participation in secondary vocational education programs by males was far less consistent. In analyses based on student self-reports, white male graduates of trade and industry programs tend to work slightly more weeks per year, white male graduates of business programs tend to go into jobs with slightly higher status, and black male graduates of both business and trade and industry programs tend to earn very slightly more than comparable graduates of high school general programs who do not go on for postsecondary schooling. But on other gainful employment outcome measures, such as unemployment rates, hours worked per week, and weeks worked per year, there appeared to be essentially no differences between male graduates of high school trade and industry and business programs on the one hand and male general graduates on the other. Moreover, even in those cases in which male self-reports of graduation from high school trade and industry and business programs did appear to be associated with employment advantages, analogous advantages were not apparent in analyses based on vocational coursework.

5.2 Do Basic Skills Increase Employment Opportunities in General?

The results we have described so far would appear to be somewhat contradictory. First, we noted that a variety of research indicates that basic skills are required for a wide range of occupations. Second, we found, in reanalyses of test data from both the TALENT and Growth surveys, that changes in test scores in reading, writing, and math, do not appear to be substantially different for vocational than for general high school students. But despite these two general findings, we did discover that secondary vocational programs, as compared with general programs of study, are associated with gainful employment advantages, particularly for females enrolled in commercial-business programs.

A natural question is whether this is plausible, that is: Can high school vocational programs yield employment advantages without showing up in test score advantages? In brief, the answer to the question is yes. Why this is so can be illuminated by reviewing recent literature on status attainment. There is a vast amount of literature on the issue of what factors seem to account for social and economic success of individuals. Indeed, this literature is far too vast for us to review thoroughly here. Thus, let us only recount several relevant findings from one of the more recent and comprehensive studies of status attainment, namely Who Gets Ahead by Christopher Jencks et al. (1979).

This volume was aimed at identifying the determinants of individual success within the economic and broader social system of twentieth century United States. Indicators of success employed in the study were mainly earnings and occupational status. The book focused on four kinds of personal characteristics as possible determinants of adult earnings and occupational success; namely, family background, cognitive skills, personality traits, and educational attainment. The study employed data from six national surveys and six special purpose surveys (including a subsample of TALENT data). The main limitation of Who Gets Ahead was that in explaining the determinants of success it focused exclusively on 25- to 64-year-old men. Nevertheless, the findings concerning the relationship between test scores and economic success were very illuminating.

For data bases in which relevant data were available, significant correlations were consistently found between school test scores and both later earnings and occupational status, generally in the range of 0.2 to 0.6 (Jencks et al., 1979, pp. 318-329).

> The association between test scores and occupational status in our samples does not depend on the age at which an individual is tested. Nor does it depend on the age at which we ascertain occupation. These six surveys imply that men whose test scores differ by fifteen points (one standard deviation) can expect to work in occupations whose status differs by one-third to one-half a standard deviation. (p. 219)

However, when family background was controlled the association between test scores and occupational status was reduced substantially. Moreover, the influence of test scores on occupational status appears to operate almost exclusively in terms of years of schooling. Those who have higher test scores early in their school careers tend subsequently to get more years of schooling. It is years of schooling which exerts far more direct influence on occupational status, rather than the skills reflected in test scores *per se*. Jencks et al. (1979) specifically concluded that "from 60 to 80 percent of the effect of adolescent cognitive skills on adult occupational status derives from the fact that adolescent cognitive skills affect educational attainment. . . Contrary to what one might expect, high test scores do not increase the percentage value of an extra year of schooling" (pp. 219-220). A similar pattern was apparent in the relationship between adolescent test scores and adult earnings (that is, a modest zero-order correlation but one that is mediated by years of schooling). The mediation of the test score-earnings relationship by years of schooling was not as substantial as the mediation by years of schooling on the test scores-occupational status relationship. As Jencks et al. commented, "Differences in education help explain why men with high test scores earn more, but nearly two-thirds of the effect of test scores on earnings is independent of men's education" (p. 121). The investigation nevertheless went on to comment that "the effects of test performance on earnings are not very large relative to the overall earnings gap between the rich and the poor in general" (p. 121).

These findings obviously suggest a very limited effect of test scores, independent of years of schooling, on occupational success. In this regard two other aspects of the analyses reported in Who Gets Ahead should be noted. First, Jencks et al. generally refer not to basic skills test scores but instead to cognitive or academic ability test scores. Using Project TALENT data, these investigators did explore the relationship between some thirty different tests and three indicators of occupational success (occupational status, hourly earnings, and log of hourly earnings). The thirty different tests dealt with academic subjects, nonacademic subjects, aptitude and ability and rote memory. It was found that in general academic tests and ability and aptitude tests tended to predict later success better than either nonacademic tests or rote memory tests. This finding obviously raises the question of which of these tests might reasonably be considered tests of the basic skills of reading and math. (None of the TALENT tests were intended to be direct tests of writing skills). Table 5.2.1 presents relevant data from Jencks et al. (1979, pp. 88-89). These data suggest that to the limited extent that adolescent test scores do predict later occupational success (none of the zero-order correlations between test scores and either occupational status or

TABLE 5.2.1 Correlations Between Three Types of Project TALENT Tests with Later Education, Occupational Status, and Earnings

Type of Test	Education	Occupation	Hourly Earnings
Academic subjects			
English	.471	.423	.164
Literature	.510	.439	.162
Social Studies	.499	.436	.176
Mathematics information	.550	.495	.219
Arithmetic computation	.338	.316	.166
Arithmetic reasoning	.425	.338	.148
Introductory mathematics	.5[illegible]5	.421	.191
Advanced mathematics	.474	.360	.176
Physical science	.454	.364	.131
Biological science	.381	.315	.107
Mean of the ten correlations	.462	.391	.164
Aptitude and ability tests			
Reading comprehension	.489	.405	.178
Vocabulary	.482	.428	.184
Creativity	.352	.311	.130
Mechanical reasoning	.256	.247	.122
Abstract reasoning	.361	.354	.153
Visualization	.268	.256	.125
Table reading	.003	.054	.087
Clerical checking	.051	.054	.092
Object Inspection	-.006	.014	.023
Mean of the nine correlations	.251	.236	.122
Measures of rote memory			
Memory for sentences	.095	.171	.040
Memory for words	.282	.228	.103
Mean of the two correlations	.189	.150	.072

Source: Extracted from Jencks et al., Who Gets Ahead?. pp. 88-89. Correlations are uncorrected for test unreliability. Test data are from 800 males tested in grade 11 in 1960, and education, occupational status, and earnings data are from a 1972 follow-up survey, when these individuals were approximately 28 years old.

earnings was as high as 0.50, or in other words, none explained as much as 25% of the variance in these indicators of occupational success), more general cognitive tests (such as mathematics information and reading comprehension) have more predictive power than the more concrete skills (such as arithmetic computation and memory for sentences). The only exception to this general pattern is that vocabulary test scores showed considerable predictive power. These data imply that it may not be specific basic skills which contribute to increased occupational success as much as it is general cognitive or academic ability, and characteristics associated with it.

This interpretation seems supported by another interesting finding reported in Who Gets Ahead. Specifically, Jencks et al. report that "tests given as early as sixth grade appear to predict educational attainment, occupational status, and earnings as well as tests given later" (pp. 85-86). The interpretation offered for this surprising finding is as follows:

> This suggests that it is not cognitive skill per se that affects later success. Rather, the stable motivations and aptitudes that lead to the development of cognitive skills also affect later success. A test's predictive power appears to derive in large part from its relationship to these stable underlying factors. (p. 86)

Taken together these findings suggest in general that basic skills attainment during secondary school has a very limited effect on adults' gainful employment -- measured either in terms of occupational status or earnings. Specifically, the research reviewed on the determinants of occupational success indicates that:

1. The relationship between adolescents' test scores and subsequent employment is mediated through years of schooling attained (though this appears to be less true for earnings than for occupational status).

2. It is more general cognitive and academic ability test scores rather than rote or more concrete basic skills, which have greater power to predict employment outcomes. (The main exception to this general pattern appears to be vocabulary tests, which as indicators of verbal ability show about as much predictive power as any other single test.)

3. Test scores from as early as the sixth grade show almost as much predictive power as test scores from the high school years.

Altogether these findings clearly suggest that the basic skills attainment of secondary vocational students are not likely to have a strong influence on their subsequent employment opportunities. Nevertheless, there are two major reasons for exercising caution in drawing inferences from the general literature on determinants of occupational success with respect to secondary vocational students. First, even though basic skill attainment may not evidence much influence on employment opportunities among broadly-representative national samples of men, it may be that <u>within</u> the population of individuals taking vocational education programs at the secondary level, basic skills attainments show more influence. Second, it is worth noting that most of the general literature on determinants of occupational success, and in particular <u>Who Gets Ahead</u>, has been based exclusively on samples of <u>males</u>. In contrast, in examining the employment outcomes associated with participation in secondary vocational education (see section 5.1), we found that advantages were most clearly apparent for females who participated in business-office programs at the secondary level. Thus, it is not unreasonable to hypothesize that the generally slim basic skills-employment relationship apparent for males in general may not apply to females who take vocational programs at the secondary level. For these reasons, in the next section, we turn to consider more direct evidence on the relationship between basic skills attainment and employment outcomes among secondary vocational students, both male and female.

5.3 Do Basic Skills Increase Employment Opportunities of Secondary Vocational Students in Particular?

As we have noted previously, there are currently no good data with which to examine interrelationships between vocational schooling, basic skills attainments, and subsequent employment success. The two data sets which we used to examine the relative basic skills attainments of secondary vocational and general students (specifically the Growth and TALENT Retest data sets, see Chapter 3) provided either no data or deficient data for such an investigation. The Growth study did not conduct any follow-ups subsequent to high school completion. While the TALENT study did conduct periodic follow-ups subsequent to high school, the response rate for these follow-ups was so poor for the Retest subsample that the Project TALENT Data Bank will not release follow-up data for this subsample. In the absence of any nationally representative data set that contains follow-up information on subsequent employment success of students for whom test score data are available both early and late in their secondary school careers, it was thus necessary to use as the basis of this section the next best data set available, one which had both follow-up employment information and end of high school test scores. This data set is the National Longitudinal Study of the High School Class of 1972 (NLS-72).

NLS-72 offers a number of advantages for addressing the questions in this section (see Woods & Haney, 1981, for a more general discussion of the advantages and disadvantages of this and other data sets for studying outcomes associated with participation in secondary vocational education programs). Among the main advantages are the following: (1) NLS-72 provides a nationally representative sample of secondary students; (2) it allows identification not only of whether students were in a general or vocational secondary program, but also the basic type of program (trade and industry, and business-office were the major types of vocational programs pursued by males and females, respectively); (3) it provides test score information on high school seniors in 1972 in both reading and math; and (4) it provides follow-up information on subsequent employment of these same individuals at three time points (entry, one year, and four years after graduation).

Although the NLS-72 data thus seem to offer the best opportunity currently available among any national longitudinal data sets for studying the relationship between basic skills attainment at the end of high school and subsequent labor market success, this data set has a number of limitations which should be mentioned. Among the main ones are the following: (1) although the NLS-72 contains reading and math test score data, it does not provide direct measures of writing skills, the third of the widely acknowledged "basic skills"; and (2) because of our previous analyses of the NLS-72 data set, we are aware that there are often discrepancies between alternative means of identifying students' high school programs (i.e., via student self-reports, administrators' designations, or records of high school coursework. See Woods and Haney, 1981, for a fuller discussion of this problem). For the sake of the analyses reported in this section, we relied upon student self-reports, for two reasons. First, student self-reports are the only means of curriculum identification available in other data sets reanalyzed for this report, and hence relying upon self-reports in analyzing NLS-72 test data makes these analyses more nearly parallel those of other data sets. Second, our previous analyses of gainful employment outcomes associated with participation in secondary vocational education tended generally to yield larger estimates of employment advantages when curriculum identification was based on self-reports than when it was based on coursework. Thus, relying on student self-reports maximizes the possibility of detecting any systematic relationships between employment advantages and reading and math test scores.

With these points in mind, let us now explain our basic strategy for reanalyzing NLS-72 data in order to address the question of whether basic skills attainment increases employment opportunities of secondary vocational students. Basic skills attainment is represented by the general reading and math test scores. These tests were administered to the NLS-72 sample in the spring of their senior year. Although these NLS-72 tests have sometimes been described as tests of ability, we eschew this terminology, for the simple reason that the distinction between ability and achievement in standardized testing has come to be more a matter of interpretation than of substance. Indeed, the terms ability and achievement are commonly (in our view too commonly) used almost interchangeably in discussions of standardized tests nowadays. NLS-72 standardized test scores were scaled so that in the total NLS-72 sample tested they had a mean of 50 and a standard deviation of 10.

We restricted our attention strictly to students who reported themselves to have pursued either a general or a vocational program of study and to have pursued no additional schooling beyond high school as of four years after high school graduation (i.e. the group which in our previous analyses of NLS-72 we call the no postsecondary group).

Given these two constraints we then divided up the sample of general and vocational students with no postsecondary education into low, medium, and high scoring individuals on the basis of grade 12 test scores. This was done separately for math and reading test scores. In this regard, it should be noted that there are a substantial number of cases in the NLS-72 data set with missing test scores. Specifically of the 3,954 cases in the population of individuals who reported following a general or a vocational program in high school and who did not pursue postsecondary education within four years of high school graduation (i.e. which we called no postsec., or 12 years exactly), 2,863 or 72.4% had test score data. The roughly 30% of the cases without test data came primarily from schools which refused to participate in the base-year NLS-72 survey. Unfortunately, these schools do not constitute a random sample of schools surveyed, but instead tend largely to be "small schools, often in the South, [and] often rural in location" (Creech, 1974, p. 7). Thus because the NLS-72 subsample analyzed for the reanalyses reported here was restricted in terms of availability of test scores, data reported below on employment indices may not agree precisely with analogous data reported in our previous study for which no restriction on test score data availability was imposed.

High, average, and low scoring groups were defined by locating cut-off score points which led to roughly 30%, 40% and 30% of our overall reanalysis sample being in these categories, respectively. Specifically the NLS-72 standardized test score ranges used to define the high, average, and low scoring groups were as follows:

	Test	Scale Score Range	Percentage of Reanalysis Sample
Reading Test	Low	40 or below	28.6%
	Average	41-51	39.3%
	High	51 or above	32.1%
Math Test	Low	39 or below	28.1%
	Average	40-48	38.9%
	High	49 or above	33.0%

Note that the groups which we have designated as average in test scores fall very largely below the general mean (50) on the NLS-72 reading and math test scores. This is because our reanalysis sample excluded two groups who tended generally to score above average on these tests, namely, those who did pursue postsecondary schooling within four years of high school graduation and those who reported their high school program to be academic or college preparatory. Thus, it should be kept in mind that our designation of high, average and low reading and math test scores refers strictly to the NLS-72 subpopulation which constituted our reanalysis sample.

Having established these designations of high, average, and low test scores, our strategy was then simply to conduct cross-tabular analyses to see whether there was any systematic relationship between high, average, and low reading or math test scores and a variety of indicators of gainful employment. Specifically, we examined four such indicators, namely, the Duncan socioeconomic index (SEI) of occupational status, weekly earnings (adjusted to 1978 dollars), number of hours worked per week, and number of weeks worked per year. These were chosen because it was for these indicators in our previous study (Woods & Haney, 1981) that we found some of the clearest differences between vocational and general high school graduates. Each of these indicators was examined at three time points, namely; at job entry (i.e., as of October following high school graduation), about one year after graduation, and about four years after high school graduation.

Additionally, as in our previous study we conducted analyses separately for four sex-race groups, namely: white males, black males, white females, and black females. The vocational specialty areas which had sample sizes sufficiently large (cell-size of 20 or more was our criterion) to allow analysis were trade and industry for males and business-office for females.

This strategy yielded approximately 200 sets of comparisons of employment indicators for high, average and low scoring groups (4 outcome measures x 3 time points, and 2 tests x 2 sexes x 2 race groups x 2 curriculum groups = 192). If there was a strong relationship between basic skills test scores and employment outcomes, what we would have expected to find was a clear trend across these comparisons, with the high scoring individuals doing better than lower scoring individuals on the indicators of employment success. In general we did not find such trends. To illustrate this general finding we present results only for Duncan SEI and weekly earnings outcome indicators. Data for the other two indicators (namely hours worked per week and weeks worked per year) are not presented both because these measures are not as widely recognized indicators of employment success as are earnings, and occupational status and because the pattern of findings did not differ.

Tables 5.3.1-5.3.4 present average Duncan SEI and weekly earnings by test score group by the various subgroups we have mentioned. The sample sizes for the four sex-race groups at each of the three time points (i.e., those both employed and having test scores) associated with these tables are reported in Appendix A.

In general samples of blacks tend to be much smaller than samples of whites. Also, individuals within each of these sex-race categories at each of the follow-up points are not evenly distributed across the two curriculum groups (general for both males and females and T & I for males, and business-office for females), and across the high, average, and low scoring categories. In general, more of the various subsamples were in the general group than in the vocational groups, and since the high, average, and low scoring groups were, as previously explained, defined on the basis of our total reanalysis sample, relatively few blacks tended to fall within the high scoring categories. Sample sizes for the reading and math tests were virtually identical since these tests were given at the same time during the spring of senior year in high school in 1972. Since sample sizes within some cells thus fell to fairly small sizes, in reporting results in the four tables which follow, we have deleted results for any cells in which the sample size was less than 20.

We first discuss results for the Duncan SEI shown in Tables 5.3.1 and 5.3.2 and then those for weekly earnings shown in Tables 5.3.3 and 5.3.4.

Duncan SEI

Tables 5.3.1 and 5.3.2 show Duncan SEI scores for males and females, respectively. Before commenting on the patterns across low, average and high scoring groups, let us first note some of the broader patterns apparent in these data. First, overall SEI scores tend to increase with increasing years after high school graduation. Note, however, that as we found in our previous study (Woods & Haney, 1981), the pattern of increase appears to vary by sex, with females showing an increase between entry and year 1 but leveling off between year 1 and year 4, but with males tending overall to show the reverse.

Second, note that among females, graduates of business-office vocational programs tend to have SEI scores considerably higher than graduates of general programs, and this difference appears to persist as long as four years after high school graduation. This difference is of course an indication of one of the major findings of our earlier study, namely, that graduation from a business-office program appears to give females a substantial employment advantage as compared with female graduates of general high school programs.

In light of such patterns, what differences in SEI scores appear to be associated with scoring high, average or low in reading and math tests? In short, the differences in SEI scores associated with scoring high, average or low on the NLS-72 reading and math tests appear to be both few in number and small in magnitude. In only 10 out of a possible 24 comparisons is there a trend apparent showing high scorers to have higher SEI scores than average scorers and average scorers higher than lower scorers. Moreover, in several cases, those scoring low on either the reading or math tests

TABLE 5.3.1: Average Duncan SEI Scores for Males with 12 Years of Schooling Exactly by High, Average, and Low Reading and Math Test Scores, by Race for General and Trade & Industry Graduates, at Entry, Year One, and Year Four After High School Graduation (NLS-72) (Weighted Averages)

Reading	Entry Year			One Year			Four Years		
	Gen.	T&I	Total[a]	Gen.	T&I	Total[a]	Gen.	T&I	Total[a]
Male-White									
Low	19.9	22.9	20.9	21.0	19.2	20.3	26.0	25.7	25.3
Ave.	21.6	22.8	22.7	24.0	25.9	24.3	26.4	26.4	26.7
High	23.6	22.9	23.8	24.2	22.5	22.2	28.6	27.2	29.6
Total	21.9	22.9	22.6	22.2	22.6	22.5	27.1	26.4	27.2
Male-Black									
Low	21.9	20.5	22.1	21.8	17.4	21.0	25.1	22.0	23.7
Ave.	*	*	*	*	*	*	*	*	*
High	*	*	*	*	*	*	*	*	*
Total	22.9	24.1	23.2	21.7	20.1	21.7	26.6	28.0	26.0
Math									
Male-White									
Low	19.9	23.1	21.1	24.2	20.6	23.1	24.1	28.4	25.6
Ave.	22.9	23.7	23.6	21.2	24.0	22.0	27.5	24.7	26.9
High	21.9	21.5	22.4	22.2	22.0	22.7	28.1	27.3	28.5
Total	21.9	22.9	22.6	22.2	22.6	22.5	27.1	26.4	27.2
Male-Black									
Low	21.6	20.2	21.7	22.9	20.5	22.7	20.8	*	21.0
Ave.	25.0	*	24.5	18.0	*	19.2	34.8	*	33.8
High	*	*	*	*	*	*	*	*	*
Total	22.9	24.1	23.2	21.7	20.1	21.7	26.6	28.0	26.0

* Unweighted sample size for cell less than 20.

[a] Total includes general, T&I, and all other vocational graduates.

TABLE 5.3.2 Average Duncan SEI Scores for Females with 12 Years of Schooling Exactly, by High, Average, and Low Reading and Math Test Scores, by Race, for General and Business-Office Graduates, at Entry, Year One, and Year Four After High School Graduation (NLS-72 (Weighted Averages)

Reading	Entry Year			One Year			Four Years		
	Gen.	Off.	Total[a]	Gen.	Off.	Total[a]	Gen.	Off.	Total[a]
Female-White									
Low	26.8	42.9	32.0	30.0	43.2	34.1	34.4	46.9	37.6
Ave.	30.1	41.8	35.7	33.5	43.0	38.7	34.7	46.5	41.3
High	33.9	41.8	37.3	35.4	43.8	39.4	38.9	48.2	42.5
Total	31.1	42.0	35.4	36.6	43.4	38.0	36.8	47.2	41.0
Female-Black									
Low	17.0	33.9	19.9	27.5	38.9	30.2	30.0	41.1	29.7
Ave.	22.0	31.0	26.8	23.6	42.6	33.0	37.1	47.1	41.3
High	*	*	*	*	*	*	*	*	*
Total	19.3	34.8	24.1	26.3	43.3	32.9	32.4	46.5	35.8
Math									
Female-White									
Low	29.0	42.8	32.4	29.3	42.1	34.4	34.4	47.4	39.0
Ave.	32.3	41.0	35.8	34.8	41.7	37.7	36.8	45.2	40.5
High	31.5	42.9	37.0	35.4	45.8	40.9	37.5	49.5	43.0
Total	31.1	42.0	35.4	33.6	43.4	38.0	36.5	47.2	41.0
Female-Black									
Low	19.2	30.7	21.4	26.6	38.1	30.5	32.6	40.1	31.7
Ave.	19.4	39.7	27.0	25.6	48.2	36.0	32.3	51.1	42.3
High	*	*	*	*	*	*	*	*	*
Total	19.3	34.8	24.1	26.3	43.3	32.9	32.4	46.5	45.8

* Unweighted sample size for cell less than 20.

[a] Total includes general, office and all other vocational graduates.

have SEI scores equivalent to or <u>higher</u> than those scoring high on these tests. For example, among male whites at four years after high school graduation from a T&I program, those scoring low on the math test had an average Duncan SEI of 28.4 while those scoring high on the math test had an average of 27.3. Among males the <u>maximum</u> SEI score difference associated with scoring low or high on either the reading or math test was only 4 points (for male whites graduating from a general program at four years after graduation). For females the maximum SEI difference associated with scoring high versus low on either test was 7.1 points (on the reading test for female whites at entry after graduating from a general program). Among white males, differences between high and low scoring groups graduating from trade and industry programs ranged from -1.6 to +3.3 SEI points. Among white females graduating from a business-office program, differences between high and low scoring groups ranged from -1.1 to +3.7 SEI points. Given that the standard deviation of SEI for the various sex-race and time-point subgroups ranged from a low of about 13 to a high of 20, it is clear that there are no significant differences in occupational status associated with these test score groups scoring high and low, at job entry, one year after graduation or four years after graduation. Findings for blacks are less clear, because of small sample sizes, but the data for blacks indicate no clear SEI differences associated with test scores. In general, then we conclude that among these NLS-72 samples of individuals graduating from the main vocational education programs, basic skills test scores during senior year at high school are not significantly associated with occupational status of subsequent jobs.

Indeed the SEI differences associated with test score differences seem remarkably small in light of other variations in SEI scores. Note, for example, that the SEI score increases from job entry to year 4 tend to be both more consistent and larger than SEI differences associated with scoring high as opposed to low on either the reading or math test. Similarly, note that while the maximum SEI difference associated with test scores among any of the female subgroups was 7.1 points, this amount is less than the SEI differences between graduates of general and business-office programs (with comparisons consistently favoring the business-office graduate by some 10-17 SEI points).

Weekly Earnings

Having reviewed the data on Duncan SEI scores, what then of weekly earnings? Data on this indicator of gainful employment are shown in Tables 5.3.3 and 5.3.4. First note some of the broad patterns apparent in these data:

-- whites earn substantially more than blacks, even after controlling for test scores;

-- males earn substantially more than females, even after controlling for test scores;

-- all sex, race and test score groups tend to earn more with increasing years after high school graduation, even after controlling for inflation (recall that all weekly earnings data were converted to constant 1978 dollars);

-- female graduates of business-office programs tend to earn more than female graduates of general programs.

Against this backdrop, what do these data reveal about the relationship between test scores and earnings? As Tables 5.3.3 and 5.3.4 indicate, there were a substantial number of cells with small numbers of blacks, so let us first discuss patterns apparent among whites. Among white males, those scoring high on both math and reading tests earn less than those scoring low more often than the reverse. Indeed, at the entry year point, white male T&I graduates scoring high on either reading or math tests earn about $30 less than their colleagues who score low on those tests. Among white male general graduates, there appears to be a slight tendency for high scorers more often to earn more weekly than low scorers, but note that in general, earnings differences between high and low scorers tend to be small.

In Table 5.3.4, we see a similar pattern for white females. Among graduates from business-office programs, high test scores are associated with lower earnings as often as they are with higher earnings. For general graduates high test scores are somewhat more often associated with earnings advantages, but differences are fairly modest -- all in the $3 to $18 per week range.

Data for blacks, males in Table 5.3.3 and females in Table 5.3.4, are less complete due to small sample sizes, but again we do not see any consistent evidence, indicating that higher test scores are associated with earnings advantages.

The magnitude of earnings differences also appear very meager in comparison to the standard deviations of earnings. Across the twelve sex-race-time point subgroups, within group standard deviations ranged from $43 (for white females at entry) to $81 (for white males at year 4). Thus even the largest of earning differences associated with test scores (i.e., low scoring white male T&I graduates at entry earn $33 more than high scorers) is equivalent to less than one-half a standard deviation.

Moreover, differences in earnings associated with test scores appear as very small in comparison to other systematic variations in earnings, specifically:

TABLE 5.3.3 Average Weekly Earnings for Males with 12 Years of Schooling Exactly, by High, Average and Low Reading and Math Test Scores, by Race, for General and Trade and Industry graduates at Entry, One Year, and Four Years after High School Graduation (In Constant 1978 Dollars, NLS-72) (weighted averages)

Reading	Entry Year Gen.	Entry Year T&I	Entry Year Total[a]	One Year Gen.	One Year T&I	One Year Total[a]	Four Years Gen.	Four Years T&I	Four Years Total[a]
Male-White									
Low	168	192	176	200	210	202	225	229	227
Ave.	170	188	175	205	216	208	235	245	217
High	172	159	168	203	191	199	223	225	224
Total	170	179	173	203	206	203	228	237	230
Male-Black									
Low	155	182	158	171	183	170	228	188	207
Ave.	*	*	*	*	*	*	*	*	*
High	*	*	*	*	*	*	*	*	*
Total	144	173	150	171	183	175	219	178	204
Math									
Male-White									
Low	167	186	172	205	195	203	213	220	215
Ave.	167	194	177	204	223	209	229	261	238
High	174	157	170	202	190	198	235	219	230
Total	170	179	173	203	206	203	228	237	230
Male-Black									
Low	156	181	156	168	185	175	225	*	205
Ave.	130	*	138	180	*	171	206	*	196
High	*	*	*	*	*	*	*	*	*
Total	144	173	150	171	183	175	219	178	204

* Unweighted sample size for cell less than 20.

[a] Total includes general, T&I and all other vocational graduates.

TABLE 5.3.4 Average Weekly Earnings (1978 Dollars) for Females with 12 years of Schooling Exactly by High, Average and Low Test Scores, by Race, for General and Business-Office Graduates at Entry, One Year and Four Years after High School Graduation (NLS-72) (weighted averages)

	Entry Year			One Year			Four Years		
	Gen.	Off.	Total[a]	Gen.	Off.	Total[a]	Gen.	Off.	Total[a]
Reading									
Female-White									
Low	100	126	113	119	139	125	139	153	139
Ave.	106	129	116	123	139	132	136	162	149
High	116	122	118	131	140	135	142	156	149
Total	109	126	116	126	139	132	139	158	147
Female-Black									
Low	100	105	113	132	143	132	148	141	142
Ave.	94	70	114	157	141	141	153	164	158
High	*	*	*	*	*	*	*	*	*
Total	100	102	116	138	148	143	146	163	151
Math									
Female-White									
Low	99	130	111	118	148	128	133	160	141
Ave.	109	126	117	129	136	132	140	156	146
High	117	123	118	127	139	135	150	160	152
Total	109	126	116	126	139	132	139	158	147
Female-Black									
Low	100	149	118	140	147	146	153	140	145
Ave.	98	115	110	137	136	133	134	175	155
High	*	*	*	*	*	*	*	*	*
Total	100	133	116	138	148	143	146	163	151

* Unweighted sample size for cell less than 20.

[a] Total includes general, office and all other vocational graduates.

-- weekly earnings increase some $50-$60 for both males and females from time of job entry to year 4;
-- black males receive weekly earnings some $20-30 less than white males;
-- females, both black and white, earn substantially less than males with sex-related earning differences tending to increase with increasing years after high school graduation.

In sum, our cross-tabular analyses provide no indication that test scores in math and reading are significantly associated with subsequent gainful employment (as indicated by Duncan SEI, weekly earnings, hours worked per week, or weeks worked per year) among graduates of secondary vocational programs who do not pursue postsecondary education within four years of high school graduation. In the next section, we sum up our overall conclusions from these analyses together with previous portions of this report.

VI. GENERAL SUMMARY

The purpose of this report has been to review a wide range of evidence concerning the interrelationship between participation in secondary vocational education, basic skills attainment, and gainful employment. In Chapter 2, we reviewed evidence concerning the basic skills requirements of jobs. We concluded a variety of research evidence substantiates the common belief that the basic skills of reading, writing and math are necessary for a wide range of occupations. However, we also concluded that it is impossible to determine the exact levels of basic skills which are functionally required for specific occupations.

In Chapter 3, we reviewed evidence from two national longitudinal data sets in order to compare the basic skills attainment of students in secondary vocational and secondary general programs. We concluded, using evidence from these two data sets, that on grade 9 and grade 11 or 12 tests of reading, writing and math, scores were roughly equivalent for secondary vocational and general students. Also, by examining changes in test scores, we concluded that basic skill test score gains of commercial program students and other vocational students, both male and female in our predominantly white samples, were not notably different from gains made by general program students. Chapter 4 provides a much more detailed summary of these findings from Chapter 2 and 3, plus a discussion of the caveats which should be noted concerning these findings.

In Chapter 5, section 5.1, we first summarized the findings of our previous study on gainful employment outcomes associated with participation in vocational education. Briefly, in this study (Woods & Haney, 1981), we found that a variety of research evidence indicates that some forms of secondary education for some types of students are associated with a variety of gainful employment advantages. Such advantages were most widely apparent for females, both black and white, graduating from business-office programs, and not going on to pursue postsecondary education. Section 5.1 presents a more detailed summary of these findings and caveats concerning them, but for a full elaboration of the basis for this general conclusion, our original report (Woods & Haney, 1981) should be consulted.

In the remainder of chapter 5, we reviewed evidence concerning the extent to which basic skills attainments, as evidenced in test scores, may contribute to employment advantages, both among the population in general, and among secondary vocational graduates in particular. In section 5.2 we reviewed recent research findings on the determinants of occupational success. This evidence indicated that basic skill attainment _per se_, independent of years of schooling completed, does not show much effect on either occupational status or earnings. Also, it was noted that tests of the more concrete or rote of basic skills do not seem to have as much power to predict later occupational success as do more general tests of cognitive or academic skills. Moreover, research indicates that tests given as early as the sixth grade seem to have as much predictive power regarding adult occupational success as do tests administered during the secondary grades; clearly raising the question of the extent to which basic skills attainments in secondary schools, as opposed to earlier academic attainments, influence adult employment opportunities.

In section 5.3 we turned specifically to address the question of the relationship between basic skills test scores and occupational success among secondary vocational program graduates. Using data from the NLS-72 survey, we found virtually no evidence that either reading or math test scores in the senior year of high school show any relationship with subsequent employment success of secondary vocational graduates either at job entry or as long as four years after high school graduation.

Overall then, where does this leave us concerning the interrelationship between secondary vocational education basic skills attainment and gainful employment? In general, and simplifying greatly, our findings indicate that:

1) basic skills do seem to be important for a wide range of occupations;

2) the basic skills attainments of those participating in general and in vocational secondary programs appear to be fairly similar;

3) graduation from secondary vocational education programs as opposed to general high school programs does appear in at least some cases to be associated with employment advantages.

On their surface these three findings could appear to be somewhat contradictory. Specifically in light of these findings, one might reasonably ask whether secondary vocational education can yield employment advantages relative to secondary general education programs, without enhancing the basic skills attainments of secondary vocational students relative to this same comparison group? The answer appears to be yes, for we found in evidence reviewed in section 5.2 and 5.3 that basic skills attainments as reflected in standardized test scores do not appear to be strongly related to employment success, once we have controlled for years of schooling attained. This finding should certainly not be interpreted to mean that the basic skills of reading, writing and math are unimportant, for a variety of evidence indicates that they are important for a wide range of occupations. However, what seems to be happening is that vocational students attain basic skills which are roughly equivalent to those of general high school program graduates, but that in addition they receive something else which gives them an edge, at least in some cases, in the job market. Exactly what this something else may be is uncertain from the available research evidence. It may be skills which are directly job-related (such as typing skills for those who seek clerical employment). It may be attitudes or personality characteristics which make them more employable. Or it may merely be certification in the eyes of potential employers, as having graduated from a vocational program. From the available evidence we have no reasonable basis on which to judge which of these alternative hypotheses -- or others -- may account for the apparent occupational success of at least some secondary vocational graduates as compared with general high school graduates. But what does seem reasonably clear is that secondary vocational education can yield employment advantages without giving clearcut advantages to its graduates in terms of basic skills attainment.

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APPENDIX A. NLS-72 Reanalysis Sample, No. of Cases, 12 Years Exactly, Used as Basis of Analyses Reported in Section 5.3

		At Entry			One Year Out			Four Years Out		
		Gen.	T&I	Total[a]	Gen.	T&I	Total[a]	Gen.	T&I	Total[a]
Males-White										
Employed, Test X_s										
Reading -	Low	159	65	286	156	62	280	159	65	285
	Ave.	256	82	417	244	81	404	247	84	408
	High	206	71	321	203	68	311	208	72	324
	Total	621	218	1024	603	211	995	614	221	1017
Employed, test X_s										
Math -	Low	122	44	215	121	43	212	125	45	217
	Ave.	231	100	406	225	96	397	233	97	403
	High	268	74	403	257	72	386	256	79	397
	Total	621	218	1024	603	211	995	614	221	1017
Not employed, test X_s		58	18	90	76	25	119	65	15	97
No test X_s		257	62	372	257	62	372	257	62	372

APPENDIX A - continued

		At Entry			One Year Out			Four Years Out		
		Gen.	T&I.	Total[a]	Gen.	T&I	Total[a]	Gen.	T&I	Total[a]
Males-Black Employed, test X_s Reading -	Low	44	23	96	40	23	90	39	21	87
	Ave.	17	11	36	17	11	36	13	10	31
	High	8	1	9	8	1	9	7	2	9
	Total	69	35	141	65	35	135	59	33	127
Employed, test X_s Males	Low	37	20	84	34	20	79	32	18	76
	Ave.	24	13	47	22	13	45	20	14	43
	High	8	2	10	9	2	11	7	1	8
	Total	69	35	141	65	35	135	59	33	127
Not employed	test X_s	13	4	17	13	4	23	23	6	31
No test X_s		56	27	101	56	27	101	56	27	101

APPENDIX A - continued

		At Entry			One Year Out			Four Years Out		
		Gen.	Office	Total[a]	Gen.	Office	Total[a]	Gen.	Office	Total[a]
C. Females-White Employed, test X_s										
Reading-	Low	120	84	256	113	86	253	96	66	206
	Ave.	203	221	481	199	228	485	159	183	390
	High	210	206	444	217	197	441	177	163	360
	Total	533	511	1181	529	511	1179	432	412	956
Employed, text X_s										
Math -	Low	140	95	288	138	101	291	110	81	235
	Ave.	207	226	488	211	225	494	165	176	384
	High	186	190	405	180	185	394	157	155	337
	Total	533	511	1181	529	511	1179	432	412	956
Not employed	test X_s	117	59	195	121	59	197	218	158	420
No test X_s		294	141	488	294	141	488	294	141	488

		At Entry			One Year Out			Four Years Out		
		Gen.	Office	Total[a]	Gen.	Office	Total[a]	Gen.	Office	Total[a]
D. Females-Black Employed, test X_s										
Reading -	Low	43	23	97	48	20	101	46	24	101
	Ave.	29	25	65	34	26	70	33	26	71
	High	6	8	16	7	8	17	5	8	14
	Total	78	56	178	89	54	188	84	58	188
Math -	Low	49	31	110	57	29	116	53	33	117
	Ave.	25	23	59	27	23	62	26	23	61
	High	4	2	9	5	2	10	5	2	10
	Total	78	56	178	89	54	188	84	58	188
Not employed, test X_s		19	7	37	8	9	27	13	5	27
No test X_s		66	37	128	66	37	128	66	37	128

[a] Total includes general, T&I, office-business and all other vocational graduates.