Connecting Education Standards and Employment: Course-taking Patterns of Young Workers

American Diploma Project: Workplace Study

By Anthony P. Carnevale and
Donna M. Desrochers
Educational Testing Service

Summary Findings

Introduction

Education has always been important in America. Ours is a not an aristocracy, but a society based on opportunity and equality, where education and hard work are the primary equalizing forces. During our country's industrial expansion early in the 20th Century, a high school education followed by hard work was the lever that propelled many workers into the middle class. But in the 1970s, globalization in product and capital markets, coupled with a technological revolution, prompted profound changes in the American economy. And over the past three decades, education—postsecondary education in particular—has proven to be a reliable path to the American middle class.

Education, of course, fulfills a broader purpose than just employment. Education has both cultural and political missions to create good neighbors and good citizens as well as an economic mission to develop good workers. Recent calls to improve the quality of elementary and secondary education in the United States are driven, at least in part, by economic realities. First, as postsecondary education becomes more important in accessing well-paying jobs, high school graduates need a solid foundation upon which they can continue their education. Second, the employment and earnings outlook for those students who do not continue their education is much bleaker today than in the past. These workers are more likely to be unemployed and their inflation-adjusted earnings have actually declined since the 1970s. And third, the economy is expected to continue to demand more skilled workers. While hard work may help workers move up a few rungs on the economic ladder, a solid educational background is the surest way to propel oneself to the top.

The increasingly strong relationship between education, employment, and earnings suggests the need for linking secondary school curriculum standards with job opportunities. Toward that end, the Workplace Study phase of the American Diploma Project was undertaken to develop mathematics and English language arts benchmarks that relied upon input from both employers and educators, as well as data on employment linked to high school course taking.[1] This study briefly outlines the economic context for evaluating educational standards in an employment framework and presents summary findings on the relationship between curriculum standards and job opportunities:

---

[1] Briefly, the methodology for the entire Workplace Study is as follows: Data analysis was the first step in the project. Employment, earnings, and training data were used to assign jobs into one of three job groups. Then longitudinal student data was used to examine the high school course-taking patterns of those students who were employed in each of the job groupings at age 26. The data then provided a starting point for developing the math and English benchmarks by indicating the primary courses taken by students in each of the different job groupings. Math and English curriculum specialists, using a number of existing exemplary benchmarks, developed the initial math and English benchmarks. The initial benchmarks were subsequently reviewed and refined by a three-person panel of language arts experts and a four-person panel of mathematics experts. These refined benchmarks were then presented to a sample of companies in different industries with diverse occupations. Employer comments were used to further refine the benchmarks. This report only details the data analysis portion of the project, see Von Zastrow (2002) for a more detailed description of the methodology used to create and refine the benchmarks. The final course benchmarks are presented in Appendix A.

- **Algebra II is the benchmark course for students aspiring to highly paid professional jobs or well-paid, white-collar jobs.**
- **Geometry is the benchmark course for students intending to work in well-paid, blue-collar jobs and low-paid/low-skilled jobs.**
- **Four years of English that is at least at grade level is a benchmark requirement in the vast majority of jobs.**

The Changing Structure of Jobs

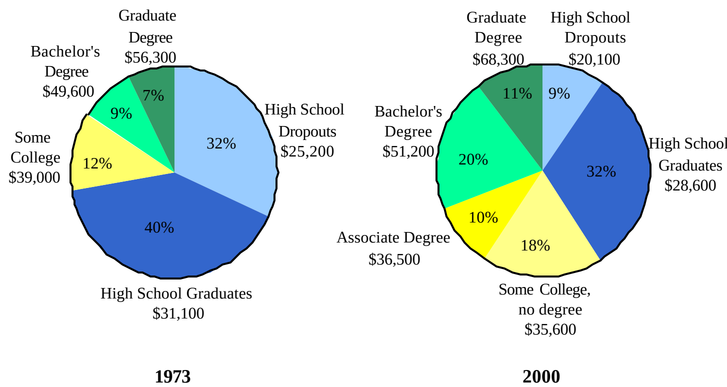
Over the past half-century, there have been two significant trends in the relationship between jobs and education. Those jobs that traditionally require the most education and offer the best pay are growing the fastest and accounting for an increasing share of all jobs in the economy. And even more significant, many jobs that now require postsecondary education previously did not.

The increase in educational requirements on the job between 1973 and 2000 is indeed remarkable. In 1973, nearly one-third of prime-age workers were high school dropouts and another 40 percent had graduated from high school but did not attend a postsecondary institution (see Figure 1). In 2000, fewer than one in ten workers were high school dropouts, while about one-third terminated their education with a high school diploma.

Figure 1

Distribution of Education in Jobs, 1973 and 2000

Percent of prime-age (30-59) employment. Earnings in 2000 dollars.



Source: Authors' Analysis of Current Population Survey (March, 1974 & 2001).

In general, educational upgrading has occurred across all occupational groups.[2] The fastest growing occupations—those in offices, classrooms, health care, and technology—while always high skilled, now employ significantly larger shares of educated workers. Generally, more than two-thirds of workers in these fast-growing occupations have completed some postsecondary education, and these jobs account for about 60 percent of all jobs in the economy. Although factory and natural resource jobs are losing overall employment shares—factory jobs declined from 32 to 17 percent of all jobs between 1959 and 2000, and natural resource jobs declined from 5 to 1.5 percent over the same period—each of these sectors has also become relatively more skilled. Low-skilled service jobs have consistently accounted for roughly 20 percent of remaining jobs since

[2] Technology adopted in the workplace has deskilled some occupations but, on balance, there has been an increase in skill requirements in the economy (Capelli, 1993 and 1996; Katz and Murphy, 1992; Levy and Murnane, 1992; Murphy and Welch, 1993). When technology is used to substitute for workers' skills, the workers' ability to add value is reduced. But when technology is used to complement the skills employees bring to the job, it increases the value they can add to the work because they are more productive.

the late 1950s and a substantial share of workers in these jobs are still completing their education.

Encouraging today's students to continue to prepare for additional education after high school is good both for the individual and the economy. Although the supply of college-educated workers has increased dramatically since the 1970s, the earnings premium for these workers relative to high school graduates had doubled by the late 1990s, from about 35 to 70 percent (Mishel, Bernstein, and Schmitt, 1999). Employers continue to pay college-educated workers higher wages, even in the face of an increasing supply of college graduates, because demand has continued to outpace supply. And additional evidence suggests that employers are not just buying degrees. Employers pay college workers employed in so-called "high school jobs" higher wages than their high school educated co-workers, indicating that they are more productive workers (Tyler, Murnane and Levy, 1995). But even for those high school graduates who do not go on to college, gaining solid skills in secondary school is important. Employers generally provide training to their most skilled employees and, among both college and non-college workers alike, those workers who receive training on the job earn more than those who do not (Eck, 1993).

The Employment Pyramid

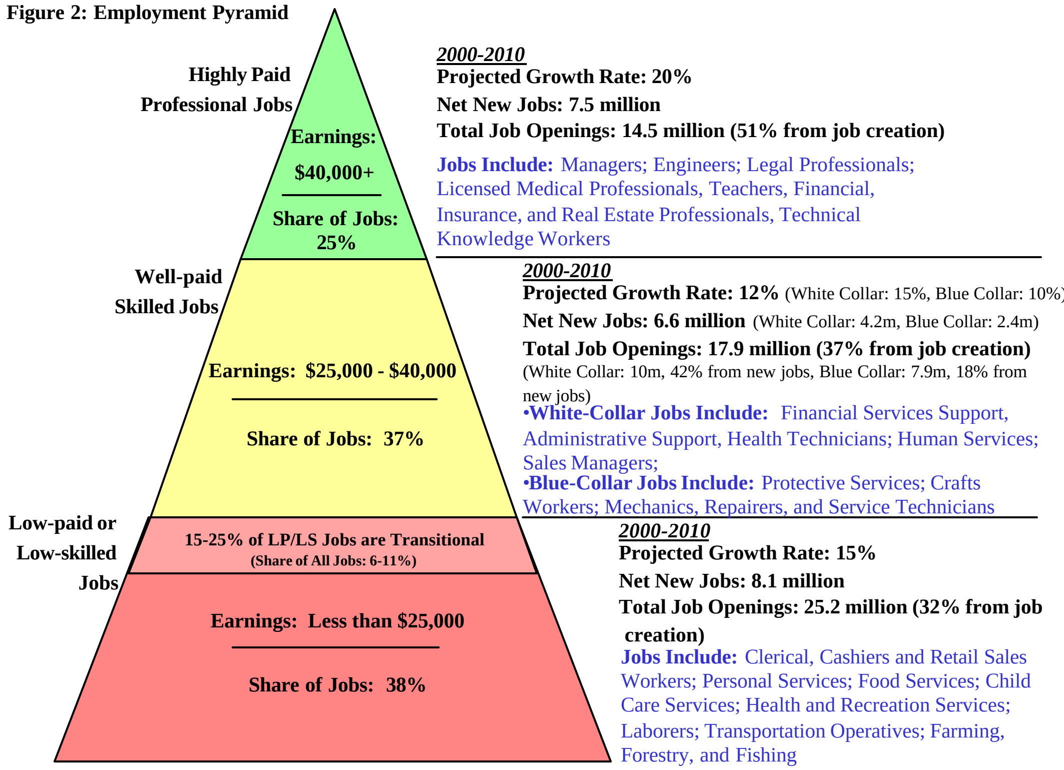
What constitutes a "good job" for today's high school graduate often differs depending on the perspective of the individual. For some, it may mean a professional or managerial job that requires a four-year degree, while for others it may mean a job with dependable hours and a reliable paycheck. But considering the difficulty in supporting a family on less than $25,000 a year—which is about 175 percent of the poverty line for a family of three—a "good job," for the purpose of this study, is defined as one that is either "highly paid" or "well paid" and falls in either of the top two tiers of the employment pyramid shown below (see Figure 2). Not only do these jobs tend to pay higher wages, they also are more likely to provide insurance, retirement benefits, and opportunities for additional education or training.

- **Highly Paid Professional Jobs:** The top tier of jobs, which accounts for about a quarter of all jobs, tends to pay workers more than $40,000 a year, on average, and includes managers and professional workers.
- **Well-paid, Skilled Jobs:** The middle tier of jobs, which accounts for about 37 percent of all jobs, generally pays workers between $25,000 and $40,000 a year, on average, and includes support workers in offices and health care settings, as well as protective service and skilled blue-collar workers.
- **Low-paid or Low-skilled Jobs:** The lower tier of jobs, accounting for about 38 percent of all jobs, generally pays less than $25,000 a year and includes retail sales, food service, child care, and personal and home health care workers, as well as less skilled manual laborers.

Together, highly paid professional jobs and well-paid skilled jobs account for about 62 percent of all jobs (full- and part-time) in the economy.[3] By 2010, they are expected to add more than 14 million new jobs and have more than 34 million total job openings (from new jobs and replacement of those who leave their occupation or the labor force). Highly paid professional jobs will grow the fastest, increasing by 20 percent, and about one-half of the job openings in those occupations will result from new job creation. Well-paid skilled jobs are expected to grow somewhat slower and a larger share of their job openings will result from job turnover rather than new job creation (37 percent). Within the well-paid job tier, white-collar jobs are projected to grow faster than average (15 percent), while blue-collar job growth (10 percent) is expected to be less robust.

Many highly paid professional jobs require a four-year college degree, while well-paid skilled jobs tend to encompass more broad preparation such as an associate degree, certificate, or other postsecondary or on-the-job training. Regardless of the source of the additional education or training, students aspiring toward a "good job" will need a solid math and English language arts education if they are to benefit from additional learning.

Figure 2: Employment Pyramid



Source: Author's analysis of Bureau of Labor Statistics Employment Projections, 2000-2010; Current Population Survey, March 2001.

[3] The distribution of jobs in the employment pyramid may differ from that derived from other data sources for several reasons. First, the distribution of jobs in the employment pyramid is based on a "jobs count," which includes all full- and part-time jobs. Other job analyses, which often use survey data, only include a person's primary job; therefore, only one job is counted even if a person works two jobs (either one full-time and another part-time, or two part-time jobs). Because low-paid or low-skilled jobs are more likely to be part time, the largest differences in the number of jobs occur at the bottom of the employment pyramid.

Course-taking by Employment Category

Students ultimately disperse among a diverse group of careers, and there are many factors that influence their career choices. Decisions about where to live may either afford or preclude employment in certain occupations, while views on the appropriate, or desired, balance between career and family makes some jobs more attractive than others. Personal interests and social responsibility also weigh heavily in career decisions. But educational choices, in particular, can provide or deny access to different careers.

Job-related skills, including cognitive skills, occupational skills, and more general "soft skills," such as communication, problem-solving, and behavioral skills, can also affect labor market outcomes. While acknowledging the many factors and skills that influence career decisions, as well as the host of education and training alternatives that students can pursue between high school graduation and settling into a career, this study looks explicitly at high school course taking in relation to subsequent employment.[4]

The following analysis uses data from the U.S. Department of Education's National Educational Longitudinal Survey (NELS), a 12-year survey following a cohort of students who were eighth-graders in 1988. The cohort graduated from high school in 1992, and by 2000 the majority of these 26 years olds were in the labor force.[5] In addition to a battery of questions on students' backgrounds, families, school activities, postsecondary education, and subsequent employment, high school transcripts provide a detailed account of the courses and grades of the survey participants while they were in high school.

Transcript data are used to evaluate math and English language arts course taking while in high school. But once on the job, it is probable that many students will not utilize the entire set of math and English language arts skills they learned. Nevertheless, the transcript data outlines the typical high school education preparation that workers either use directly on the job, or draw upon and use indirectly—through the cognitive abilities they developed by taking these courses—to learn new tasks that they do use on the job.[6]

[4] While this study does not address the intermediate role of postsecondary education or training in obtaining subsequent employment, analysis of high school course takings is still relevant. For some workers, the skills gained in high school influence employment opportunities directly. However for others, it influences employment indirectly by first providing access to postsecondary education or training that then allows them to access a particular job.

[5] The sample drawn for this analysis included tenth-grade students in 1990 who graduated from high school in 1992 and were employed in 2000 (and earning at least $5,000 a year). A complete high school transcript, with greater than 16 credits and positive English credits, was also required to be included in the sample. Excluded from the analysis were high school dropouts and those students who graduated ahead of or behind schedule.

[6] Even a casual analysis of the distribution of occupations demonstrates that relatively few of us—fewer than 5 percent—make extensive use of geometry, algebra II, trigonometry, or calculus on the job. In the year 2000, there were 146 million people in the workforce. Roughly three million were in "computer and mathematical occupations," including actuaries and statisticians. There were roughly 1.5 million engineers and architects and 1.2 million life, physical, and social scientists. In addition, there were 132,000 secondary school science teachers and 180,000 secondary school mathematics teachers (Hecker, 2001). But the fact that only 5 percent of us use advanced mathematics on the job does not mean that we should stop teaching algebra, geometry, trigonometry, or calculus in high schools. In the current educational curriculum, these

The findings, described in more detail below, show that mathematics course taking varies widely by employment tier; however, English language arts course taking shows significantly less variation.

Mathematics

Workers employed in the highest-paying jobs have taken more high school mathematics courses than workers in lower-paying jobs—and the courses they took also were more rigorous. Nearly all workers, regardless of where they were employed within the distribution of jobs, had at least two credits of math (see Table 1). But the highest-paid workers were more likely to have continued their mathematics education beyond two credits. Among highly paid professional workers, 90 percent had at least three math credits, and more than one-half had accumulated credits equivalent to at least four years of math. Forty percent of middle-tier, white-collar workers had at least four math credits, significantly more than well-paid, blue-collar workers or workers in low-paid/low-skilled jobs.[7]

Table 1: High School Math Credits Earned by Students Employed in 2000, by Employment Group

	All Jobs	Low-paid or Low-skilled Jobs	Well-paid Skilled Jobs			Highly Paid Professional Jobs		
			Total	*Blue-Collar*	*White-Collar*	Total	*Managers/Other*	*Science/Math[1]*
Student took…								
1 or more math credits	100%	100%	100%	100%	100%	100%	100%	100%
2 or more math credits	99%	98%	98%	97%	99%	99%	99%	100%
3 or more math credits	81%	71%	78%	71%	82%	90%	90%	93%
4 or more math credits	39%	27%	34%	23%	40%	56%	54%	74%
N	6,424	1,628	2,652	*780*	*1,872*	2,144	*1,868*	*276*
Weighted Population	1,739,989	422,324	766,431	*264,267*	*502,164*	551,234	*481,112*	*70,122*

Note: This subsample includes those 1990 high school sophomores who graduated in 1992, had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed and earning at least $5,000 in 2000.

[1.] Includes doctors, engineers, architects, software engineers, scientists, statisticians, and computer programmers.

Source: Authors analysis of NELS 88:2000.

In addition to taking more math, workers in the highest-paying jobs also take more complex math. More than one-half of workers in the highest-paid tier of jobs had two or more credits at the algebra II level or higher,[8] compared with 27 percent of middle-tier workers and 20 percent of bottom-tier workers.

We estimate that three-fourths of those in the top-paying 25 percent of jobs have at least one yearlong high school credit in algebra II (see Table 2). More than 85 percent have taken geometry. Twenty-seven percent of those in the top-paying jobs have at least

---

higher-level courses are the means by which people learn higher-level reasoning skills even if they are not directly applicable on the job.

[7] Within the middle tier of jobs (well-paid, skilled jobs), course-taking patterns are muddied by the vast differences in the high school experiences of well-paid, blue-collar workers and well-paid, white-collar sales and support workers. In fact, the math course-taking patterns of white-collar workers more closely reflect that of professional workers, while blue-collar workers' math education is similar to that of workers in low-paid/low-skilled jobs.

[8] In this analysis, the mathematical hierarchy is defined from highest to lowest as follows: calculus, statistics and other advanced math, pre-calculus, trigonometry, algebra II, geometry, algebra I, pre-algebra, and general math.

a semester of pre-calculus and roughly 20 percent have taken calculus. Among those employed in well-paid, middle-tier jobs, more than one-half have taken algebra II, and more than two-thirds have taken geometry in high school. But separating out well-paid, blue-collar workers who have high earnings but take a less rigorous course load, more than six in ten well-paid, white-collar workers have taken algebra II and more than three-quarters have taken geometry.

Table 2: Share of High School Math Courses Taken by Students Employed in 2000, by Employment Group

	All Jobs	Low-paid or Low-skilled Jobs	Well-paid Skilled Jobs			Highly Paid Professional Jobs		
			Total	*Blue-Collar*	*White-Collar*	Total	*Managers/Other*	*Science/Math*[1]
Advanced math	15%	8%	11%	*5%*	*14%*	27%	*25%*	*47%*
Calculus	10%	4%	6%	*2%*	*8%*	20%	*16%*	*43%*
Statistics and other advanced math	7%	4%	5%	*3%*	*7%*	10%	*10%*	*8%*
Pre-calculus, trigonometry, or algebra II	61%	48%	55%	*38%*	*64%*	80%	*79%*	*87%*
Pre-calculus (.5)	17%	9%	14%	*6%*	*18%*	27%	*25%*	*39%*
Trigonometry (.5)	12%	8%	10%	*6%*	*12%*	18%	*17%*	*25%*
Algebra II only	59%	47%	53%	*37%*	*61%*	76%	*76%*	*81%*
Geometry	73%	61%	70%	*55%*	*78%*	86%	*86%*	*87%*
Algebra I	73%	71%	75%	*73%*	*76%*	72%	*74%*	*58%*
Pre-algebra	22%	24%	26%	*35%*	*22%*	15%	*15%*	*11%*
General math	23%	35%	27%	*41%*	*20%*	10%	*10%*	*4%*
N	6,424	1,628	2,652	*780*	*1,872*	2,144	*1,868*	*276*
Weighted Population	1,739,989	422,324	766,431	*264,267*	*502,164*	551,234	*481,112*	*70,122*

Note: Columns do not sum to 100 because students may take more than one mathematics course.
Data include courses where at least one credit (.5 credit in Pre-calculus or Trigonometry) and
a passing grade were earned. This subsample includes those 1990 high school sophomores who graduated in 1992,
had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed
and earning at least $5,000 in 2000.
[1.] Includes doctors, engineers, architects, software engineers, scientists, statisticians, and computer programmers.
Source: Authors analysis of NELS 88:2000.

Clearly, algebra II is the threshold mathematics course taken by people who eventually get professional or other good white-collar jobs in the top half of the earnings distribution.[9] And the more mathematics beyond algebra II, the better the odds of eventually landing a job in the top 25 percent of the earnings distribution.

At the bottom of the distribution in American jobs, roughly 70 percent have at least a yearlong credit in algebra I, 61 percent have geometry, and slightly fewer than half have algebra II. While many skilled blue-collar workers—employed as machine operators, mechanics, repair technicians, skilled crafts workers, or working in the protective services—have specialized vocational training that affords them high-wage jobs, these workers are less likely to have pursued high levels of math in high school. Among well-paid, blue-collar workers nearly three-quarters took algebra I, but just slightly more than one-half took geometry and fewer than four in ten took algebra II. And while skilled crafts jobs afford good pay and benefits, these jobs are generally not growing as fast as the higher-skilled services jobs in the economy. Coupled with the productivity gains in manufacturing, declines in factory employment, and union membership declines, these

[9] The threshold for selecting a minimum benchmark course was targeted at those courses where approximately two-thirds of workers had taken a particular course or a higher level of math. Selecting a lower threshold, of 50 percent for instance, could result in a course recommendation that is seemingly too high, since just as many workers with and without the coursework would have had access to the jobs. Similarly, targeting a higher threshold, of say 90 percent, could result in a course recommendation that is too low, since nearly all workers would have completed the course.

good paying jobs may be increasingly difficult for future graduates to obtain and, absent a solid education foundation, more difficult to retrain in case of worker dislocation.

In most high schools, the recommended sequence of mathematics courses follows a traditional hierarchy. Following that hierarchy and looking at the "highest level of mathematics completed," the fault line most pronounced within the traditional course hierarchy is algebra II. Across the board, algebra II was the highest level of math for about 30 percent of workers (see Table 3). But aggregating the highest level of math shows that a strong majority of workers in highly paid professional jobs (84 percent) have taken at least algebra II or a higher-level math course. Looking only at white-collar workers in well-paid jobs, two-thirds have taken at least algebra II or a higher level math.

Table 3: Distribution of Highest High School Math Course Taken by Students Employed in 2000, by Employment Group

		Low-paid or	Well-paid Skilled Jobs			Highly Paid Professional Jobs		
	All Jobs	**Low-skilled Jobs**	**Total**	***Blue-Collar***	***White-Collar***	**Total**	***Managers/Other***	***Science/Math*** [1]
Calculus	10%	4%	6%	*2%*	*8%*	20%	*16%*	*43%*
Statistics	5%	4%	5%	*3%*	*6%*	8%	*8%*	*3%*
Pre-calculus (.5)	11%	7%	10%	*5%*	*13%*	15%	*15%*	*18%*
Trigonometry (.5)	7%	5%	6%	*4%*	*7%*	9%	*9%*	*8%*
Algebra II	31%	30%	30%	*25%*	*33%*	32%	*33%*	*18%*
Geometry	15%	17%	18%	*20%*	*17%*	10%	*11%*	*6%*
Algebra I	10%	16%	12%	*20%*	*8%*	3%	*3%*	*3%*
Pre-algebra	4%	6%	5%	*7%*	*4%*	2%	*2%*	*1%*
General math	6%	11%	7%	*13%*	*4%*	2%	*2%*	*0%*
No course with more than 1 credit	0%	0%	0%	*0%*	*0%*	0%	*0%*	*0%*
	100%	**100%**	**100%**	***100%***	***100%***	100%	*100%*	*100%*
N	6,424	1,628	2,652	*780*	*1,872*	2,144	*1,868*	*276*
Weighted Population	1,739,989	422,324	766,431	*264,267*	*502,164*	551,234	*481,112*	*70,122*

Note: Highest math course is one where a passing grade and at least one credit (.5 credit in Pre-calculus or Trigonometry) were earned. This subsample includes those 1990 high school sophomores who graduated in 1992, had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed and earning at least $5,000 in 2000.

[1.] Includes doctors, engineers, architects, software engineers, scientists, statisticians, and computer programmers.

Source: Authors analysis of NELS 88:2000.

Among workers in the bottom tier of the employment distribution, fully one-half of workers in the lowest job tier have completed algebra II or a higher level math, as compared to only about 40 percent of blue-collar workers. Including those workers who took geometry, estimates suggest that geometry is the threshold course for these jobs. Two-thirds of workers in the lower tier of the employment distribution and roughly 60 percent of blue-collar workers took geometry or a higher level math.

What is clearly evident is that for most high school students, setting the bar at advanced levels of math, such as pre-calculus or calculus, would hold students to a standard that is unnecessarily high. Only one in five students employed in the well-paid professional jobs completed a course in high school calculus and, even among the math and science-related workers, such as doctors, scientists, engineers, and computer programmers, only 43 percent took calculus in high school. At the same time, however, top-tier workers were more than three times as likely as those in the middle tier, and five times as likely as those in the lowest job tier, to have taken calculus.

Because there are many more predictors of job attainment than just mathematics course taking, simply taking algebra II does not guarantee a good job. In fact, among those students who took algebra II, nearly one in five were employed in low-paid or low-skilled jobs (see Table 4).[10] Nevertheless, algebra II does increase the likelihood of being employed in a good job.

Algebra I is the tipping point between the lowest tier of jobs and the top two tiers of well-paid and highly paid jobs. Those students who take a math course that is more difficult than algebra I tip the scales in favor of a good job, as they are more likely than average to be working in a top- or middle-tier job. Likewise, students who took less difficult courses were more likely than average to end up in lower-tier jobs.

Among those students who took algebra II, the share of workers in good jobs was 5 percentage points greater than average, and 10 percentage points greater than average for those in white-collar and professional jobs. The likelihood of obtaining a good job increased with additional higher-level mathematics courses.

Table 4: Employment Distribution of Students Employed in 2000 by Highest High School Mathematics Course

										Row Sum of Jobs that are:		
		Weighted	Low-paid or	Well-paid Skilled Jobs			Highly Paid Professional Jobs			Well and	White-Collar	Row
	N	Population	Low-skilled Jobs	Total	*Blue-Collar*	*White-Collar*	Total	*Managers/Other*	*Science/Math*[1]	Highly Paid	and Highly Paid	Sum
Total	**6,425**	**1,740,408**	**24%**	**44%**	***15%***	***29%***	**32%**	***28%***	***4%***	**76%**	**61%**	**100%**
Advanced math	1,097	268,406	12%	32%	*5%*	*26%*	56%	*44%*	*12%*	88%	83%	100%
Calculus	747	172,225	10%	27%	*4%*	*23%*	63%	*46%*	*18%*	90%	87%	100%
Statistics and other advanced math	425	114,196	15%	37%	*7%*	*30%*	48%	*43%*	*5%*	85%	78%	100%
Pre-calculus, trigonometry, or algebr	4,146	1,065,248	19%	40%	*10%*	*30%*	41%	*36%*	*6%*	81%	71%	100%
Pre-calculus (.5)	1,295	239,476	12%	37%	*6%*	*31%*	51%	*41%*	*9%*	88%	82%	100%
Trigonometry (.5)	884	210,301	16%	37%	*7%*	*30%*	47%	*38%*	*8%*	84%	77%	100%
Algebra II only	3,962	1,024,799	19%	40%	*10%*	*30%*	41%	*36%*	*6%*	81%	71%	100%
Geometry	4,776	1,272,001	20%	42%	*12%*	*31%*	37%	*33%*	*5%*	80%	68%	100%
Algebra I	4,744	1,275,567	24%	45%	*15%*	*30%*	31%	*28%*	*3%*	76%	61%	100%
Pre-algebra	1,270	381,441	26%	52%	*24%*	*28%*	21%	*19%*	*2%*	74%	50%	100%
General math	1,388	407,608	36%	51%	*27%*	*25%*	13%	*12%*	*1%*	64%	38%	100%

Note: Data reflect that students may take more than one mathematics course.
Data include courses where at least one credit (.5 credit in Pre-calculus or Trigonometry) and
a passing grade were earned. This subsample includes those 1990 high school sophomores who graduated in 1992,
had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed
and earning at least $5,000 in 2000.
[1.] Includes doctors, engineers, architects, software engineers, scientists, statisticians, and computer programmers.
Source: Authors analysis of NELS 88:2000.

All totaled, the data on mathematics course taking results in the following conclusions:

Algebra II is the threshold for well-paid, white-collar jobs or highly paid professional jobs.

- The "highest level of math" completed by 84 percent of workers in highly paid professional jobs, and 67 percent of workers in well-paid, white-collar jobs is "algebra II or a higher level course."
- Among highly paid professional workers, 76 percent completed algebra II, while 61 percent of well-paid, white-collar workers completed algebra II.
- Among workers who took geometry, algebra II, or a higher level math, a higher than average share were employed in good jobs.

[10] The distribution of jobs estimated using the NELS survey data differs, for several reasons, from that of the U.S. labor force as a whole. First, the employment distribution for the total population includes all age groups, while the NELS sample is restricted to a younger and more educated cohort that graduated from high school in 1992. And unlike the NELS sample, the U.S. labor force includes high school dropouts and immigrants who were not educated in U.S. secondary school system. As a result, the NELS sample is relatively more educated and, therefore, less likely to be employed in low-paid/low-skilled jobs than the general labor force.

Geometry is the benchmark-level course for students who are ultimately employed in well-paid skilled blue-collar jobs or low-paid/low-skilled jobs.

- Two-thirds of low-paid/low-skilled workers have completed "geometry or a higher level math," as have almost 60 percent of well-paid, blue-collar workers.
- Just over 70 percent of workers in each of these two employment groups have completed algebra I, while 61 percent of low-paid/low-skilled workers and 55 percent of blue-collar workers had completed geometry.
- Workers who took geometry or a higher level math were less likely than average to be employed in a low-paid/low-skilled or well-paid, blue-collar job.

English Language Arts

Strong preparation in English language arts[11] provides an edge in the labor market, but the advantages are subtler than for math. In most English courses, there was little difference in course-taking patterns among employment groups. More than 94 percent of workers across the employment distribution completed a course in literature, composition, or English 12 as their highest-level English language arts course. Considering only survey English courses,[12] nearly all workers completed at least one credit of English, and about 95 percent completed at least two credits (see Table 5, Panel A). While fewer in the sample completed three or four survey English credits, about six in ten did complete four or more credits in survey English.

Estimates of grade-level survey English courses also show a similar incidence of course taking across the distribution of jobs. However, the proportion of students taking additional survey English courses did decline as the students progressed through high school—only about two-thirds of students took English 12. Some students may opt to take an elective English course as they reach their upper-secondary years. One-half of students had at least .5 credits in either a literature or composition course, while another 20 percent earned at least .5 credits in a speech course (see Table 5, Panel B).

Literature and composition are two of the courses where there were slight differences in course taking between each of the different employment groups. While one-half of workers in well-paid skilled jobs earned at least .5 credits in literature or composition, slightly more than one-half (54 percent) of workers in highly paid professional jobs and fewer than one-half (45 percent) of workers in low-paid/low-skilled jobs earned similar credits. A second difference in course-taking patterns occurs among workers in low-paid/low-skilled jobs where 7 percent took at least one credit in a below-grade English course or English as a second language (ESL) courses, a share that is twice that of workers in good jobs.

[11] Throughout this document, the terms "English" and "English language arts" are used interchangeably.

[12] Many language arts courses are classified by year in school rather than by content. Survey English includes English 9, English 10, English 11, and English 12, which are then further classified by four levels of rigor—fundamental, basic, regular, or honors. Literature, composition, speech, and below-grade English or English as a second language (ESL) are separate from survey English courses.

Table 5: English Course taking by Students Employed in 2000, by Employment Group

Panel A	All Jobs	Low-paid or Low-skilled Jobs	Well-paid Skilled Jobs	Highly Paid Professional Jobs
Student took…				
1 or more survey English credits	99%	99%	99%	99%
2 or more survey English credits	94%	95%	94%	95%
3 or more survey English credits	79%	81%	77%	79%
4 or more survey English credits	60%	61%	58%	60%
Panel B				
Student took at least 1 credit in…				
English 9	94%	94%	93%	94%
English 10	88%	88%	88%	89%
English 11	73%	77%	71%	73%
English 12	67%	67%	66%	68%
Literature or Composition (.5)	50%	45%	50%	54%
Literature (.5)	30%	26%	30%	32%
Composition (.5)	28%	26%	28%	30%
Speech (.5)	19%	17%	20%	20%
Below Grade English or ESL	4%	7%	3%	3%
N	6,424	1,628	2,652	2,144
Weighted Population	1,739,989	422,324	766,431	551,234

Panel A Note: Survey English includes English 9-12. It does not include below-grade English, literature, composition, speech, or ESL.

Panel B Note: Credit threshold for some courses is .5 credits, as indicated.
Note: Columns do not sum to 100 because students may take more than one English course. This subsample includes those 1990 high school sophomores who graduated in 1992, had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed and earning at least $5,000 in 2000.
Source: Authors analysis of NELS 88:2000.

Taking an in-depth look at the rigor of survey English courses does show that workers in the highest-paid jobs are more likely to take regular and honors-level English. In all job categories, the share of workers who earned credits in functional or basic English courses was small—generally fewer than one in ten students (see Table 6). Nevertheless, the share of workers in white-collar skilled jobs and professional jobs who took these functional and basic English courses was less than one-half of the share of workers in low-paid/low-skilled jobs who engaged in these courses.

The majority of workers in the sample took regular, survey English courses. At first glance, it appears that more workers in low-paid/low-skilled jobs took regular English than did workers in good jobs. But the balance of those workers in good jobs took honors English rather than regular English. About 94 percent of workers took English 9, but among low-paid/low-skilled workers, only about 8 percent took honors English 9, as compared with 12 and 19 percent of workers in well-paid and highly paid jobs, respectively (see Table 6).

Previous data showed that survey English course taking diminished equally across job groups. When used in combination with data on the rigor of survey English courses, we see that among those students who continued to take survey English as they progressed through high school, a larger share in each employment tier took honors

English. But still, among the highest-paid workers taking a survey English course, about 38 percent (26 percent of the 68 percent who took English 12) took honors English, compared with only 15 percent of lower-tier workers and 20 percent of middle-tier workers.[13]

Table 6: Share of Survey English Courses Taken by Students Employed in 2000, by Employment Group

	All Jobs	Low-paid or Low-skilled Jobs	Well-paid Skilled Jobs			Highly Paid Professional Jobs		
			Total	*Blue-Collar*	*White-Collar*	Total	*Managers/Other*	*Science/Math*[1]
Students took at least 1 credit in…								
Functional or Basic:								
English 9	6%	7%	7%	*14%*	*4%*	4%	*5%*	*1%*
English 10	5%	7%	6%	*13%*	*3%*	2%	*2%*	*1%*
English 11	3%	6%	4%	*7%*	*2%*	1%	*1%*	*1%*
English 12	3%	6%	3%	*5%*	*2%*	1%	*1%*	*0%*
Regular:								
English 9	74%	78%	74%	*74%*	*75%*	70%	*71%*	*63%*
English 10	68%	73%	70%	*73%*	*68%*	61%	*63%*	*53%*
English 11	56%	63%	56%	*62%*	*53%*	51%	*52%*	*41%*
English 12	48%	51%	50%	*61%*	*45%*	42%	*44%*	*31%*
Honors:								
English 9	13%	8%	12%	*5%*	*16%*	19%	*18%*	*26%*
English 10	15%	9%	12%	*5%*	*15%*	24%	*23%*	*31%*
English 11	13%	8%	11%	*5%*	*14%*	21%	*19%*	*29%*
English 12	16%	10%	13%	*6%*	*16%*	26%	*25%*	*31%*
N	6,424	1,628	2,652	*780*	*1,872*	2,144	*1,868*	*276*
Weighted Population	1,739,989	422,324	766,431	*264,267*	*502,164*	551,234	*481,112*	*70,122*

Note: Columns do not sum to 100 because students may take more than one English course. This subsample includes those 1990 high school sophomores who graduated in 1992, had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed and earning at least $5,000 in 2000.
Source: Authors analysis of NELS 88:2000.
[1.] Includes doctors, engineers, architects, software engineers, scientists, statisticians, and computer programmers.
Source: Authors analysis of NELS 88:2000.

Likewise, looking at the eventual employment of students who took less rigorous survey English shows they were less likely to be employed in good jobs. Students who had taken at least one credit in below-grade English or ESL were almost twice as likely to be employed in a low-paid/low-skilled job (44 percent versus 24 percent for the total sample) and less likely to be working in a good job. Those students who took functional or basic English were more likely than average to be working in low-paid/low-skilled jobs, particularly if they did not move into regular English courses as they progressed through high school. Among those students still taking functional or basic English in the twelfth grade, 44 percent were employed in the lowest-tier jobs—the same percent as those students who took below-grade English or ESL.

Students who enroll in honors English courses are more likely than average to be employed in good jobs. The share of honors English course takers who are in good jobs is roughly 10 percentage point above average, while the share that are employed in white-collar skilled jobs or highly paid professional jobs is about 20 percentage points above average. Those students who took an elective English course, such as literature, composition, or speech, may have a very slight advantage in accessing the highest-paying

[13] Although not shown, the data on total survey English credits when broken out by blue-collar, white-collar, science/math professionals, and other professionals are similar to the data presented for the three job tiers. When broken down by the functional categories, the workers in blue-collar jobs again had course-taking patterns more similar to low-paid/low-skilled workers. The course-taking patterns of white-collar workers continued to be higher than those groups, but were lower than workers in highly paid professional jobs. Workers in science/math jobs also had the highest shares of honors English course taking (see Table 6).

jobs the labor market. Since most students enroll in regular survey English courses, the employment distribution of those students who take regular survey English generally

Table 7: Employment Distribution of Students Employed in 2000 by Highest High School English Courses

										Row Sum of Jobs that are:		
		Weighted	Low-paid or	Well-paid Skilled Jobs			Highly Paid Professional Jobs			Well and	White-Collar	Row
	N	Population	Low-skilled Jobs	Total	*Blue-Collar*	*Whit- Collar*	Total	*Managers/Other*	*Science/Math* [1]	Highly Paid	and Highly Paid	Sum
Total	**6,424**	**1,739,989**	**24%**	**44%**	**15%**	**29%**	**32%**	**28%**	**4%**	**76%**	**61%**	100%
Students took at least 1 credit in…												
Literature or Composition (.5)	3,438	867,537	22%	44%	*12%*	*32%*	34%	*30%*	*4%*	78%	66%	100%
Literature (.5)	1,999	516,947	21%	44%	*10%*	*34%*	34%	*30%*	*5%*	79%	68%	100%
Composition (.5)	1,922	488,608	23%	44%	*10%*	*34%*	34%	*29%*	*5%*	77%	68%	100%
Speech (.5)	1,342	334,764	22%	46%	*14%*	*32%*	32%	*29%*	*4%*	78%	64%	100%
Functional or Basic:												
English 9	346	108,339	27%	50%	*33%*	*17%*	22%	*22%*	*1%*	73%	40%	100%
English 10	282	87,185	32%	57%	*40%*	*17%*	11%	*11%*	*1%*	68%	28%	100%
English 11	227	60,801	42%	47%	*29%*	*18%*	12%	*11%*	*1%*	58%	29%	100%
English 12	182	53,352	44%	45%	*26%*	*19%*	11%	*11%*	*0%*	56%	30%	100%
Regular:												
English 9	4,866	1,288,520	26%	44%	*15%*	*29%*	30%	*27%*	*3%*	74%	59%	100%
English 10	4,373	1,177,976	26%	45%	*16%*	*29%*	29%	*26%*	*3%*	74%	58%	100%
English 11	3,591	975,816	27%	44%	*17%*	*27%*	29%	*26%*	*3%*	73%	56%	100%
English 12	2,957	833,402	26%	46%	*19%*	*27%*	28%	*25%*	*3%*	74%	55%	100%
Honors:												
English 9	794	231,189	15%	39%	*6%*	*34%*	45%	*38%*	*8%*	85%	79%	100%
English 10	915	259,127	14%	34%	*5%*	*29%*	52%	*43%*	*9%*	86%	81%	100%
English 11	879	230,474	14%	37%	*5%*	*31%*	49%	*41%*	*9%*	86%	81%	100%
English 12	1,027	282,741	15%	35%	*6%*	*29%*	50%	*42%*	*8%*	85%	79%	100%
Below Grade English or ESL	298	67,559	44%	33%	*12%*	*21%*	24%	*21%*	*3%*	56%	45%	100%

Note: Columns do not sum to 100 because students may take more than one English course. This subsample includes those 1990 high school sophomores who graduated in 1992, had an available transcript, earned at least 16 total credits, and had positive English credits, and were employed and earning at least $5,000 in 2000.
Source: Authors analysis of NELS 88:2000.

[1.] Includes doctors, engineers, architects, software engineers, scientists, statisticians, and computer programmers.
Source: Authors analysis of NELS 88:2000.

mirrors that of the total population.

Evaluating the similarity in credits earned across employment groups, in conjunction with the varied employment outcomes given the rigor of different survey English courses, suggests the following conclusions:

All students, regardless of their eventual employment, tend to complete four years of English of sufficient rigor that it is at least at the regular, on-grade level.

- The quantity of English courses among workers does not vary significantly by employment tier. In each employment tier, two-thirds of workers took English 12, and six in ten took at least four credits in survey English.
- The quality of English course taking does matter. Taking below-average English or functional/basic English increases the likelihood of being employed in a low-paid or low-skilled job. Honors English and elective courses, such as composition, literature, or speech, may provide a slight labor market advantage, but most students who took a solid course load of regular survey English had sufficient access to good jobs.

The Importance of Education in an Economic Framework

The data relating math and English language arts coursework to subsequent employment are compelling. But other types of skills have also shown to contribute to future employment and earnings.

Cognitive Skills

Apart from just slugging through school, those students who actually learn from their coursework and develop higher cognitive abilities fare better in the labor market. Rather than looking at jobs, most research focuses on the relationship between cognitive test scores and earnings.

Looking at the earnings of young workers, differences in mathematics test scores while in high school shows they are associated with significant differences in subsequent earnings. In one study, the average hourly rate for 31-year-old workers who had been in the top quartile on a high school mathematics test was $6.05 greater than those in the bottom quartile. The comparable difference between the top and bottom quartiles on the science score was $5.44, and on the paragraph comprehension, $4.17. Combining mathematics, science, and paragraph comprehension into a composite score, workers who scored in the top quartile earned about 20 percent more than those in the bottom quartile (Decker et al., 1997).

The earnings effects that result from cognitive abilities are not always immediately apparent. There is little association between the academic scores and hourly pay until workers are in their early 20s. But at about age 23, those in the higher score quartiles begin to earn significantly more, while those in the lowest quartile show little improvement in their earnings through their early 30s (Decker et al., 1997). It seems likely that those who scored well while in high school most likely continued their education and moved from low- to better-paying jobs after completing this further education.

Even when controlling for other factors that influence earnings, mathematics achievement, as reflected in math test scores, consistently has a positive impact on subsequent earnings. Estimates suggest that a standard deviation increase in test scores corresponds to an increase in hourly wages at age 24 of about 5 to 7 percent for males and 8 to 11 percent for females. In 1988 dollars, that translated to an increase of up to $0.57/hour for men and $0.74/hour for women (Grogger and Eide, 1995; Murnane, Willett, and Levy, 1995). Similar research using vocabulary test scores did not show a significant relationship to wages, although a one standard deviation increase in perceptual speed and accuracy test scores was related to an hourly wage increase of 3% for men and 2% for women (Grogger and Eide, 1995).

General Skills: Reasoning, Problem-Solving, and Behavioral Skills

Little is known about how to develop and assess general problem-solving and behavioral skills in students and workers, but most employers associate them with educational attainment, especially college-level attainment. Educational attainment also is used as a proxy for reasoning ability. As a result, American employers use education and training attainment as the most reliable standard by which to screen job applicants.

The new applied skill requirements have emerged, in part, as a result of the changing occupational structure of the economy. Increasing productivity in manufacturing and other technology intensive industries means that fewer workers with specific technical skills are needed to do the same amount of work. And because most of the new positions are being created in business services, education, health care, and office jobs, fewer technical skills and more general skills typical of these jobs are required. Broader and more general skills also are required because of the spread of “high-performance work systems" that locate broader responsibilities to work teams at the point of production and service delivery.

The new office, education, and health care jobs that are growing in the U.S. economy, require higher levels of interpersonal and problem-solving skills because the work entails higher levels of human interaction and personalized responses to people's wants and needs. These same behavioral skills are required in high-technology and manufacturing jobs as well, because the technology itself takes on more of the rote, manual processing tasks allowing employees to spend more time interacting with each other in order to exploit the new flexible technologies capable of providing higher quality, variety, and speed of operation.

In both manufacturing and services, these new problem-solving and behavioral skills are also required in order to create new kinds of value added. Unlike the old manufacturing-based economy where simple productivity—high volume at low cost—was paramount, the new economy demands new kinds of value, measured by a more complex set of performance standards and workers with the broad skills to meet them. These new kinds of value include quality, variety, customization, customer focus, speed of innovation, and the ability to add novelty and entertainment to products and services.

For instance, companies that make or sell quality products or deliver quality service need workers with solid academic and occupational preparation. But good academic basics do not guarantee quality. Companies that meet quality standards require conscientious employees who are able to take responsibility for the final product or service—regardless of their position in the company. Variety and customization require workers who are creative and good at problem solving.

Continuous innovation requires a general ability to learn and work in groups. Adding novelty and entertainment value requires creativity. The growing consumer demand for customization and variety requires workers with problem-solving skills that emphasize the flexible application of reasoning abilities in multifaceted work contexts. To continuously improve products and services, institutions require employees up and down the line to have leadership and learning skills. Successful teamwork and good customer service require interpersonal and communication skills.

Positive Cognitive Style and Personality

The new, fast-paced, and unforgiving global economy results in constant change in skills required for specific jobs. Constant economic and technological change also discourages growth in job tenure and increases the overall rate of job creation and job destruction. The subtlest behavioral asset in managing school, work, and life in the constant flux of modern times is a positive cognitive style (Seligman, 1998).

The notion of "positive cognitive style" is more than "self-esteem" or "the power of positive thinking." "Self-esteem" and "positive thinking" are internal attitudes that persist irrespective of external experiences of success or failure. Cognitive styles are the various ways people process information gained from experience. Cognitive psychologists tend to agree that the way people explain events to themselves, or their cognitive style, is a key determinant of success and failure. Those with a negative cognitive style tend to see failure as a result of causes that are "permanent, pervasive, and personal." They tend to discount successes as temporary, limited in scope, and unrelated to personal merit (Seligman, 1998). People with a negative cognitive style tend to be less successful because they cede control over the choices in their lives to their circumstances, reducing their ability to act and persevere. Cognitive style helps explain why some succeed against the odds and others fail in spite of their advantages.

Studies on personality also show that some personality traits correlate with success on the job. For example, "conscientiousness" correlates positively with job performance, the ability to learn on the job, and positive personnel data such as low absentee rates (Barrick and Mount, 1991; Mount and Barrick, 1998; Tett, Jackson, and Rothstein, 1991; Tett et al., 1994). While the relationship between "positive cognitive style" and "conscientiousness" is not well established, it seems logical that cognitive styles are among the mediating forces that determine successful traits like "conscientiousness." Among managers and sales workers, an extroverted personality also was positively correlated with job performance, training proficiency, and low absenteeism. And across all occupations, openness to experience and extroversion were positively associated with the ability to be trained on the job (Mount and Barrick, 1998).

Occupational and Professional Competencies

The general reasoning, problem-solving, and behavioral skills, as well as a positive cognitive style, are critical for lifelong learning and success in modern labor markets but, at some point, everyone has to put an occupational point on his/her educational pencil. There is a general consensus that occupational preparation—or college-level coursework leading toward occupational or professional preparation—should begin sometime in high school. Some high school students begin to receive occupational preparation through vocational programs and other applied curricula. For the most part, these programs survive as an alternative applied pedagogy to meet statewide academic performance standards and as preparation for further postsecondary education. Among those who terminate their education with high school, the half that need training get it primarily from their employers.

For most high school students, occupational preparation continues or begins after high school with enrollment in occupationally oriented programs in degree and nondegree granting postsecondary programs. A much smaller share continue their education past the first four years of college and gets their occupational or professional credentials in graduate or professional schools.

Test scores in nonacademic, occupational-focused areas showed a relationship with hourly wages similar to that of more academic knowledge. In one study, a composite score was derived from tests in auto and shop knowledge, electronics, mechanical knowledge, and numerical operations. After controlling for other variables, a one standard deviation increase in their nonacademic composite corresponded to an increase in hourly wages of about 6 percent (Blackburn and Neumark, 1993).

Conclusion

There is a vast array of employment opportunities available to youth entering the labor market in the United States today. And there are many factors that influence the type of jobs in which youth engage. Economic conditions play a substantial role in shaping available job opportunities. If past trends continue, and they are expected to, the United States will require many more skilled workers in the years to come. Not only are skilled jobs growing the fastest, but also existing jobs will require more educated workers today than in years past.

If today's youth want to access these good-paying jobs the economy is creating, they will need a solid high school education. Certainly other types of skills and work-life choices impact career decisions, but without a solid educational base, the foundation of skills needed either on the job or to access additional education and training that get them the job will not be laid. More than any generation before, today's youth can access whatever career they want—as long as they are held to strong educational standards and are provided with the instruction and assistance they need to meet them.

References

Barrick, Murray R., and Michael K. Mount. 1991. "The Big Five Personality Dimensions and Job Performance: A Meta-Analysis." *Personnel Psychology* 44, No. 1 (Spring).

Blackburn, McKinley L., and David Newmark. 1993. "Omitted-ability Bias and the Increase in the Return to Schooling." *Journal of Labor Economics* 11, No. 3 (July).

Cappelli, Peter. 1996. "Technology and Skill Requirements: Implications for Establishment Wage Structures." *New England Economic Review* (May/June).

Cappelli, Peter. 1993. "Are Skill Requirements Rising? Evidence From Production and Clerical Jobs." *Industrial and Labor Relations Review* 46, No. 3 (April).

Decker, Paul T., Jennifer King Rice, Mary T. Moore, and Mary R. Rollefson. 1997. *Education and the Economy: An Indicators Report*. U.S. Department of Education. National Center for Education Statistics, NCES 97-269. Washington, DC: U.S. Government Printing Office.

Eck, Alan. 1993. "Job-Related Education and Training: Their Impact on Earnings." *Monthly Labor Review* 16, No. 10 (October).

Grogger, Jeffrey, and Erik Eide. 1995. "Changes in College Skills and the Rise in the College Wage Premium." *The Journal of Human Resources* 30, No. 2 (Fall).

Hecker, Daniel E. 2001. "Occupational Employment Projections to 2010." *Monthly Labor Review* 124, No. 11 (November).

Katz, Lawrence, and Kevin Murphy. 1992. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors." *Quarterly Journal of Economics* 107, No. 1 (February).

Levy, Frank, and Richard J. Murnane. 1992. "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations." *Journal of Economic Literature* XXX (September).

Mount, Michael K., and Murray R. Barrick. 1998. "Five Reasons Why the 'Big Five' Article Has Been Frequently Cited." *Personnel Psychology* 51, No. 4 (Winter).

Mishel, Lawrence, Jared Bernstein, and John Schmitt. 1999. *The State of Working America, 1998-99*. Armonk, NY: M. E. Sharp, Inc.

Murphy, Kevin M., and Finis Welch. 1993. "Occupation Change and the Demand for Skill, 1940-1990." *AEA Papers and Proceedings* 83, No. 2 (May).

Seligman, Martin E. P. 1998. *Learned Optimism: How to Change Your Mind and Your Life*. New York: Pocket Books.

Tett, Robert P., Douglas N. Jackson, and Mitchell Rothstein. 1991. "Personality Measures as Predictors of Job Performance: A Meta-Analytic Review." *Personnel Psychology* 44, No. 4 (Winter).

Tett, Robert P., Douglas N. Jackson, Mitchell Rothstein, and John R. Reddon. 1994. "Meta-Analysis of Personality-Job Performance Relations: A Reply to Ones, Mount, Barrick, and Hunter." *Personnel Psychology* 47, No. 1 (Spring).

Tyler, John, Richard J. Murnane, and Frank Levy. 1995. "Are More College Graduates Really Taking 'High School' Jobs?" *Monthly Labor Review* 118, No. 12 (December).

Von Zastrow, Claus. 2002. American Diploma Project Workplace Study Findings. Unpublished Mimeo. Washington, DC: National Alliance of Business.

Appendix A

American Diploma Project, Workplace Study
English Language Arts and Mathematics Benchmarks

ENGLISH LANGUAGE ARTS BENCHMARKS

1. Interpret and use vocabulary to understand and communicate effectively in a range of social, professional and cultural contexts.

a) Use knowledge of individual words in unknown compound words to predict their meaning.

b) Use knowledge of common Greek and Latin derived roots and affixes to determine the meaning of complex words.

c) Infer word meanings through identification and analysis of analogies and other word relationships and clues (e.g., restatement, comparison, contrast, cause and effect) to determine the meaning of words.

d) Use context to support word identification and to confirm word meaning.

e) Understand and explain "shades of meanings" for related words.

f) Understand and explain the figurative and metaphorical use of words in context.

g) Use common antonyms, synonyms, homophones, homonyms, and homographs precisely.

2. Comprehend, evaluate and apply informational and technical texts for practical use.

a) Ask and respond to clarifying questions concerning essential textual elements of exposition (e.g., why, who, what, what-if, where, when, and how).

b) Know and use different reading strategies (e.g., skimming and scanning; finding information to support particular ideas) and the various functions of language (e.g., to inform, to persuade, to entertain) to comprehend informational text.

c) Follow complex multiple step directions (e.g., to apply for a bank savings account, library card, employment application).

d) Identify and interpret the central ideas (stated or implied) of text.

e) Locate and interpret major and minor facts and details that support ideas or arguments in text.

f) Distinguish among facts, supported inferences and opinions in text.

g) Recognize a sequence of facts, details or other information in text and apply that understanding to implement procedures or solve problems.

h) Summarize events and ideas of text.

i) Apply knowledge of expository text structures that are explicitly and implicitly stated in order to gain meaning from text. (e.g., comparison/contrast, problem/solution, sequence-time relationships, cause/effect, classifications, and generalizations).

j) Compare and contrast the treatment and scope of information on the same topic after reading several passages or articles.

k) Describe how one part of a passage functions in relation to a whole passage and how each paragraph contributes to the focus of an essay.

l) Synthesize information from different portions of text to draw subtle inferences, conclusions or generalizations about the people, ideas and/or situations.

m) Interpret and use graphic sources of information such as maps, charts, graphs, timelines, tables and diagrams.

n) Explain how writers focus ideas, provide sufficient evidence, and use arguments by causation, analogy, authority, emotion and logic to make their point.

o) Draw conclusions about an author's implicit and explicit philosophical assumptions and beliefs about a subject based on evidence in the selection.

p) Negotiate through text to determine its focus, coherence, logic, internal consistency and organizational patterns.

q) Evaluate the merit of an argument, action, or policy by examining evidence offered in the material itself and by comparing the evidence with information available in other sources.

r) Recognize and analyze instances of bias and stereotyping in text (print or electronic).

s) Explain how a director or designer of film, television, CD-ROM, or website draws the listener's or viewer's attention to a particular point, paying attention to sound and images as well as to words.

t) Compare and contrast the features and elements of consumer materials (e.g., warranties, contracts, product information and instructional manuals).

u) Understand the impact of the structure and format of functional workplace documents, and how authors use these features to achieve their purposes (e.g., anticipate reader misunderstandings, visual appeal and interest).

v) Evaluate the effect of rhetorical devices in public documents (policy statements, speeches, debates, and platforms) and how authors use these features to achieve their purposes (e.g., appeal to certain audiences, address reader concerns or counterclaims).

3. Access, appreciate and analyze various types of literature for the purposes of:

- **Developing a sense of personal integrity and ethics;**
- **Articulating personal and organizational mission;**
- **Creating empathy within and across cultures;**
- **Sharpening perception and analytical ability; and,**
- **Developing rigorous habits of mind.**

a) Understand how the forms of literature, including poetry, prose, dramatic literature, fiction, non-fiction, science fiction, short story, auto-biography, biography shape the message and present themes differently across genres.

b) Describe elements of setting (place, historical period, time of day); plot (exposition, conflict, rising action, falling action and resolution); theme (moral, lesson, meaning, message, view or comment on life); and characterization (qualities, motives, actions, thoughts, development) in literary works.

c) Compare and contrast works that express a universal theme by examining the motivations and reactions of a variety of literary characters confronting similar situations or conflicts (e.g., man vs. nature; freedom and responsibility; individual and the society; meaning of friendship).

d) Distinguish between the concepts of theme in a literary work and author's purpose in an expository text.

e) Describe how the author's perspective or point of view affects the text.

f) Describe the ways in which a literary work reflects the traditions, themes, issues and perspectives of a particular place or time period (e.g., dialect, language use, clothing, type of work, modes of transportation).

g) Recognize and define how mood or meaning is conveyed through literary elements and techniques, including figurative language, allusion, diction, dialogue, description, allegory and symbolism.

h) Evaluate the aesthetic qualities of text and how an author's choice of words and imagery sets the tone, advances the work's theme, and appeals to the senses.

i) Evaluate the impact of ambiguities, subtleties, contradictions, paradoxes, ironies, incongruities, and overstatements/understatements in text.

j) Analyze the themes, structure, and elements of myths, traditional narratives, and classical literature and provide textual evidence (examples, details, and quotations) to develop and support the interpretation.

k) Define how mood or meaning is conveyed in poetry by:
   1) Sound (word choice, alliteration, onomatopoeia, rhyme scheme, consonance, assonance, rhythm, repetition);
   2) Form (ballad, sonnet, couplet, epic, lyric);
   3) Figurative language (personification, metaphor, simile, hyperbole);
   4) Graphic elements (capital letters, line length, word position, punctuation).

l) Identify and describe the function of dramatic conventions such as dialogue, scene design, monologues, soliloquies, chorus, asides and character foils.

4. Employ the mechanics and structures of correct English to communicate effectively in writing and speaking.

a) Identify parts of speech (e.g., nouns, verbs, adverbs, adjectives, and pronouns) and their functions.

b) Use correct grammar and mechanics, including:
   1) Present, past and future perfect and perfect progressive verb tenses;
   2) Regular and irregular verbs in various tenses;
   3) Consistent verb tense;
   4) Correct subject-verb agreement;
   5) Correct word order;
   6) Verbals (participles, gerunds, infinities);
   7) Adjectives (comparative and superlative forms) and adverbs;
   8) Prepositional phrases;
   9) Nominative, objective, possessive, reflexive and relative pronouns;
   10) Pronoun/antecedent agreement and clear pronoun reference;
   11) Irregular plurals (e.g., sheep);
   12) Contractions with pronouns and verbs.

c) Use correct punctuation, including:
   1) Appropriate ending punctuation;
   2) Commas in a series, greetings and closures;
   3) Correct internal punctuation, including commas, colons, semi-colons, and hyphens;
   4) Apostrophes in contractions and possessives;
   5) Quotation marks when appropriate.

d) Capitalize proper nouns, geographical names, dates/holidays, historical periods, special events, magazines, newspapers, names of organizations, titles, first word in quotations, first word in a sentence, the pronoun "I."

e) Know the logical significance of different words and syntactic structures (e.g., because, if-then, unless, only, if, including, but, and).

f) Spell correctly.

5. Use spoken language that is coherent, concise and appropriate to audience and occasion; listen to, evaluate, and respond appropriately to oral communications.

a) Paraphrase information shared orally by others.

b) Summarize major ideas and supporting evidence presented in spoken messages and formal presentations.

c) Assess how language choice and delivery affect the mood, tone, and emotion of the oral communication and impact the audience.

d) Understand how the musical elements of literary language affect understanding (e.g., rhymes, repeated sounds, cadence, and onomatopoeia).

e) Identify the speaker's point of view and attitude about a subject.

f) Distinguish between a speaker's opinions and verifiable facts.

g) Evaluate the credibility of the speaker (e.g., hidden agendas, slanted or biased material).

h) Recognize strategies used by media to inform, persuade, entertain and transmit culture (e.g., advertising, perpetuation of stereotypes, use of visual representations, special effects and language).

i) Analyze types of arguments used by the speaker, including argument by causation, analogy, authority, emotion and logic and identify logical fallacies present in oral addresses (e.g., attack ad hominem, false causality, red herring, overgeneralization, bandwagoning).

j) Analyze the features and context of celebrated speeches (e.g., Lincoln's *Gettysburg Address* and Martin Luther King's *I Have a Dream*) for their rhetorical impact and historical significance.

k) Give precise directions and instructions such as in games and tasks.

l) Deliver focused oral presentations that:
   1) Recognize and use elements of classical speech form (introduction, first and second transitions, body and conclusion);
   2) Formulate sound, rational arguments and apply the art of persuasion and debate;

3) Use details, examples, anecdotes or experiences to explain or clarify information or point of view;
4) Employ eye contact, speaking rate, volume, enunciation, inflection, oral fluency, vocal energy, and gestures to communicate ideas effectively;
5) Demonstrate understanding of the rules of the English language and are appropriate to purpose, audience, and context (informal usage for effect, standard English for clarity, technical language for specificity).

m) Use agreed-upon rules for informal and formal discussions such as active listening, staying on topic or creating an appropriate transition to a new topic, building on ideas of previous speakers, posing relevant questions, showing consideration of others' contributions, avoiding sarcasm and personal remarks, and gaining the floor in appropriate ways.

6. Use written language that is coherent, concise and appropriate to audience and occasion.

a) Know and use the stages of the writing process (prewriting, drafting, revising, editing and publishing).

b) Use outlines or other graphic organizers to clarify ideas for writing.

c) Write simple, compound and compound-complex sentences with effective coordination and subordination of ideas to express complete thoughts (parallel structures, major phrasal and clausal constituents, and modifiers).

d) Combine short related sentences with appositives, participial phrases and prepositional phrases, avoiding problematic comma splices, run-on sentences, and sentence fragments.

e) Create paragraphs that:
1) Establish and support a central idea with a discernable topic sentence;
2) Include supporting sentences with simple facts, details and explanations;
3) Include a concluding statement that summarizes the points, are indented properly, or otherwise show a paragraph break.

f) Compose clear, coherent, and focused writings according to conventions in different modes, including:
1) Narratives (e.g., biographies, autobiographies and short stories) that:
   - Engage the reader by establishing a context and point of view;
   - Establish a plot and locate scenes and incidents in specific places;
   - Narrate a sequence of events;
   - Develop characters or relate ideas, memories, or observations;
   - Develop narrative elements with concrete sensory details and language (e.g., visual details of scenes; descriptions of sounds, smells, specific actions; dialogue; movements and gestures; interior monologue or feelings of characters);

- Effectively pace the presentation of actions to accommodate time/ mood changes;
- Provide a sense of closure to the writing.

2) Expository texts including essays of description, explanation, cause and effect, comparison and contrast and problem/solution that:
   - State the thesis or purpose of the paper, describing the situation;
   - Follow an organizational pattern particular to its type (e.g., if description, is spatial; if problem/solution, is paired);
   - Offer cogent evidence for the validity of the description, proposed solutions, etc.;
   - Provide a sense of closure to the writing.

3) Persuasive texts that:
   - Engage the reader by establishing a context and a point of view;
   - Structure ideas and arguments in a sustained and logical fashion;
   - Clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations, illustrations, and/or expressions of commonly accepted beliefs and logical reasoning;
   - Use specific rhetorical devices to back up assertions (e.g., via an appeal to logic through reasoning; via an appeal to emotion or ethical belief; or by personal anecdote, case study or analogy);
   - Anticipate and address the reader's concerns and counterclaims;
   - Provide a sense of closure to the writing.

4) Descriptions that:
   - Engage the reader by establishing a context and a point of view;
   - Provide a spatial perspective on the object being described;
   - Establish the author's relationship with the object (e.g., objective, involved);
   - Make effective use of factual descriptions of appearance, concrete images, shifting perspectives and vantage points and sensory detail;
   - Provide a sense of closure to the writing.

5) Responses to literature that:
   - Engage the reader by establishing a context and a point of view;
   - Advance a judgment that demonstrates a comprehensive grasp of the significant ideas of works or passages;
   - Support key ideas and viewpoints through accurate and detailed references to the text or to other works;
   - Demonstrate awareness of the author's use of stylistic devices and an appreciation of the effects created;
   - Identify and assess the impact of perceived ambiguities, nuances and complexities within the text;
   - Provide a sense of closure to the writing.

6) Work-related text (resumes, bios, job applications, procedures, work orders, briefs) that:
    - Address audience needs, stated purpose and context in an efficient manner;
    - Follow the conventional style for the type;
    - Make use of appropriate writing strategies, such as creating a visual hierarchy, using white space and graphics as appropriate, and providing smooth transitions between sections or steps of the text;
    - Include relevant information and exclude extraneous information;
    - Anticipate problems, mistakes, and misunderstandings that might arise for the reader.

7) Write personal and business letters, memos, thank you notes, invitations, and other correspondence that:
    - Address knowledge and interests of the audience, stated purpose and context;
    - Follow the conventional style for the type;
    - Include the date, proper salutation, body, closing and signature.

g) Understanding how a work changes when it is adapted from print to electronic media, apply and adapt principles of “good writing” to create multimedia productions using effective images, text, music, sound effects, or graphics to present a distinctive point of view on a topic (presentations, electronic communications).

h) Revise writing, drawing upon understanding of principles of organization, transitions, point-of- view, and word-choices to improve the coherence of ideas and clarity of sentence structure.

i) Edit for appropriate use of grammar and mechanics, as described in the Conventions section above.

i) Understand and use quotations, paraphrasing, in-text citations and bibliographic citations in a standard format.

7. Conceive, plan and carry out rigorous, wide-ranging research projects that:
- **Gather and synthesize relevant information from a variety of print and electronic sources, as well as from direct observation, interviews and surveys;**
- **Culminate in written, electronic, or oral products that convey research findings in a format suitable to audience and occasion.**

a) Formulate open-ended research questions suitable for inquiry and investigation and adjust questions as necessary while research is conducted.

b) Narrow the focus of a research question and develop a plan for conducting research.

c) Demonstrate ability to use a variety of resources, both print and electronic (e.g., reference books, atlases, news sources, microfiche, electronic databases, educational reference software, on-line resources).

d) Use organizational features of printed text, including table of contents, chapter titles, headings, graphic features, guide words, glossaries, citations, end notes, bibliographic reference, and indices to research information for specific purposes.

e) Use organizational features of electronic text such as bulletin boards, entry and pull-down menus, databases, keyword searches and e-mail addresses to research information for specific purposes.

f) Use resources such as dictionaries, thesauruses, and glossaries to locate the meanings, pronunciations, and derivations of unfamiliar words and to find correct spellings, synonyms, and replacement words.

g) Gather and synthesize information from observations, surveys, and interviews.

h) Differentiate between primary and secondary source materials.

i) Skim materials (print or electronic) to develop a general overview of content or to locate specific information.

j) Summarize and organize information from multiple sources by taking notes, outlining ideas, paraphrasing information, and making charts, conceptual maps, learning logs, and timelines.

k) Interpret and use graphic sources of information such as maps, charts, graphs, timelines, tables and diagrams.

l) Apply understanding of techniques used in electronic or online presentations to distinguish between facts and misleading information.

m) Differentiate between paraphrasing and using direct quotations in a report.

n) Document information and quotations by using a consistent format for footnotes or endnotes.

o) Understand the importance of citing research sources and use standard bibliographic format to document print, electronic, and other resources.

p) Produce research products in various media that create an organizing structure appropriate to purpose and specified audience that:
   1) Engage the reader by establishing a context;
   2) Marshal evidence in support of a thesis and related claims including information on all relevant perspectives;
   3) Convey information and ideas from primary and secondary sources accurately and coherently;

4) Paraphrase and summarize all perspectives on the topic as appropriate;
5) Make distinctions about the relative value and significance of specific data, facts and ideas;
6) Organize and record information on charts, maps and graphs for use as visuals;
7) Anticipate and address the reader's potential misunderstandings, biases and expectations;
8) Use technical terms and notations accurately;
9) Provide a sense of closure;
10) Cite research sources and use standard bibliographic format to document sources.

q) Use common word-processing, desktop publishing, spreadsheet, and database applications (or programs or packages) to create documents, manage information, and produce reports.

MATHEMATICS BENCHMARKS

1. Pre-requisite Knowledge

a) Make estimates or approximations to a pre-assigned degree of accuracy.

b) Demonstrate fluency in the use of scientific notation, including the ability to tell with ease the relative magnitudes of two numbers in scientific notation.

c) Convert between units of the same measurement system (e.g., inches to yards, centimeters to kilometers, square feet to square miles).

d) Use spreadsheets (e.g., in problems related to statistics).

2. Algebra I

a) Demonstrate fluency in computations with (positive and negative) fractions and decimals, and in working with ratios, rate, percent, and simple and compound interests.

b) Reason symbolically, including fluency in computations with symbolic expressions such as polynomials and rational forms, as well as equations and inequalities which contain symbols.

c) Set up problems by converting verbal information related to everyday life (e.g., salaries, commercial transactions, and measurements) into symbolic expressions or equations involving polynomials and rational forms (e.g., setting up problems).

d) Solve linear equations in two variables and systems of such, explain why the graph of a linear equation is a straight line, and interpret symbolic quantities in terms of graphic or verbal information (e.g., the m in $y=mx+b$ is the slope of the graph, and the solutions of a linear system of a pair of equations give the coordinates of the point of intersection of the pair of lines).

e) Understand the concept of a linear function, and that problems related to proportional reasoning are in reality problems about linear functions without constant terms.

f) Solve quadratic equations and interpret the symbolic quantities in terms of graphic or verbal information (e.g., the roots of $y=ax^2 +bx +c$ are the x-intercepts of the graph, and the graph is an upward parabola if $a>0$).

g) Know why the graph of a linear inequality in two variables is a half plane, know how to solve a system of linear inequalities, and know how such systems arise from scientific or commercial contexts.

h) Determine whether a symbolic statement (equation or inequality) in x is true for all values of x, or for some values of x only, or for no value of x.

3. Geometry

a) Translate visual information into precise geometric language (e.g., "two objects look alike" means precisely that "one can be obtained from the other by a dilation followed by a rigid motion").

b) Make a coherent, logical (multi-step) argument, starting with a hypothesis and ending in a conclusion, to explain why a statement is true.

c) Know the basic formulas in geometric measurements (e.g., those involving angles, length, area, and volume), have an intuitive understanding of why they are true, and solve problems using them.

d) Know the relationship between congruence and basic isometries (i.e., translation, rotation, and reflection), and between similarity and dilation.

e) Write proofs (in any format) for basic facts about congruence and similarity, and solve problems with them (e.g., the Pythagorean theorem, the base angles of isosceles triangles, the area formula of a trapezoid, why the sum of angles of a triangle is 180 degrees, and why three parallel lines intercept proportional segments on two transversals).

f) Solve problems involving the circle and explain some basic facts (e.g., why a tangent is perpendicular to the radius, how to define the number pi correctly, and why pi appears in both the circumference and area formulas of a circle).

g) Know how to set up coordinates in the plane and 3-space, and know the basic formulas such as distance between points, equations of planes perpendicular to a given line, and vector addition in terms of coordinates.

4. Algebra II

a) Locate the maximum and minimum of quadratic functions, understand how the discriminant influences the location of the graph in the coordinate plane, understand how the coefficients of the polynomial influences the shape of the graph, and how to apply these facts to the solution of word problems.

b) Understand the concept of an inverse function, why only increasing or decreasing functions can have inverse functions, and know how the graphs of a function and its inverse are related.

c) Know the definition of an exponential function, and understand intuitively why it has an inverse function called its logarithm. Know and be able to prove the basic algebraic properties of both exponential and logarithmic functions, and know how to apply these functions to solve problems, including those on growth and decay.

d) Know that rational numbers, real numbers, and complex numbers are fields, demonstrate fluency in the field operations of all three, and understand why complex numbers are needed.

e) Know and be able to prove basic properties about polynomial functions (e.g., the relationship between roots and factorization, existence of rational roots, properties of roots of unity).

f) Have intuitive understanding of an infinite series, know how to sum a finite or infinite geometric series, why the formulas are true, and know how to use them to solve word problems.

g) Define the trigonometric functions on the basis of the theory of similar triangles, extend their domains of definition to all real values (with exceptions on a discrete set), know they are periodic, and know how to use them to model periodic phenomena and solve surveying-type problems.

h) Use sine and cosine to describe the unit circle ($\sin^2 x + \cos^2 x = 1$), know their addition theorems, know how to use the latter to prove double angle and half angle formulas for both.

i) Know the trigonometric functions of special angles: 30, 45, 60, 90, 180.

5. Probability

a) Know that probability measures the likelihood that an event occurs in terms of numbers between 0 and 1, and that if the probability of an event is p, then 1-p is the likelihood of the event not occurring.

b) Know informally the concept of a "sample space."

c) Know the difference between dependent and independent events, make simple calculations of the two kinds of probability, using standard tools.

d) Answer probability questions based on the normal distribution, know that the mean and standard deviation are the two controlling parameters, and know the rule of thumb for percentage of data within 1, 2, 3 standard deviations. (Requires ideas of central tendency and dispersion listed below.)

e) Determine expected value in problem-solving situations.

6. Data Interpretation

a) Organize and represent sets of data using frequency tables, histograms, pie charts, scatter plots, line and bar graphs, stem and leaf diagrams, box and whisker plots; able to identify graphical distortion (e.g., unequal interval sizes in a histogram).

b) Understand and compute numerical descriptors of a set of data (e.g., maximum, minimum, range, mean, median, mode, percentiles, variance, and standard deviation).

c) Understand the effect of outliers.

d) Apply a curve to fit a scatter plot (e.g., by using a spreadsheet). Make predictions from a curve, and understand which predictions are likely to be reliable and which are less likely to be reliable.

e) Understand some of the issues involved in data collection, including the possible sources of bias; as well as the uses and misuses of statistics.