

The Pot of Gold at the End of the Rainbow

Johnny had better not drop math if he wants to get rich.

By John Bishop

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The wage premium for attaining a college degree in the United States is higher now than ever before. In the United States, college graduates who have majored in physical science, engineering and business earn substantially more than graduates who have majored in education, humanities or social sciences other than economics. The differences across fields are sometimes as large as the wage gains accruing to those obtaining higher-level degrees.

Relative to majors in humanities and social sciences other than economics, engineers received 45-70% higher starting salaries in 1991; computer scientists received a 38% premium, physical science majors received a 24% premium and business majors received a 10% premium. Studies of the earnings of adults indicate that the salaries of business majors tend to catch up with the engineers, but education and liberal arts majors remain far behind those with engineering, physical science and business degrees.

American studies indicate that mathematical and technical skills of average workers generate much greater wage and productivity benefits than verbal and scientific skills. The effect of mathematics reasoning proficiency is quite large. This result suggests that the educational reformers are indeed correct in urging major improvements in mathematics education for the great mass of high school students. The policy implications of these findings, at least for the US, are that mathematics, particularly algebra, geometry and statistics, should receive much greater emphasis in the secondary school curriculum.

In addition to the premium for mathematical proficiency, technical competence appears to be rewarded by substantially higher salaries. This premium implies that broad technical literacy may be useful to many workers. Consequently, students need to receive greater exposure to computers and other technologies.

There are no data on the productivity consequences of greater knowledge of history, geography and foreign languages. The economic case for greater emphasis on English and science in high school rests largely on the pipeline argument — these competencies are necessary for success in college. *These conclusions must for now be tentative for much more research is required on the contribution of particular skills and competencies to productivity of individuals and competitiveness of nations.*

In general, however, the effect of overall academic achievement on wage rates and productivity of adults is quite large. This in turn implies that the 1.25 grade level equivalent decline in the test scores of American secondary school graduates between 1967 and 1980 signaled a significant deterioration in the quality of young entrants into the American work force. The decline of student test scores was unprecedented for, prior to 1967, student test scores had been rising steadily for more than 50 years.

This decline in test scores has ominous implications for our nation. It is possible to estimate the impact of changes in academic achievement on the quality of labour. For example, one estimate is that increases in years of schooling raised labour quality in the US by .725% per year between 1948 and 1973. My own work suggests that improvements in academic achievement at given amounts of schooling contributed an additional .212% per year to the growth of the quality of labour during this period.

The test score decline reduced this contribution to .16% per year between 1973 and 1980, and .085% per year in the 1980s. If the test scores of high school graduates had continued to grow at the rate that prevailed between 1942 and 1967, labour quality would now be 2.9% higher. The social cost in terms of foregone GNP is now \$86 billion dollars annually. Even with rapid improvements in the quality of elementary and secondary education, the labour quality shortfall would grow to 5.5% in 2000 and 6.7% in 2010. The social costs of deteriorating school quality may be even greater.

It would appear that the education enterprise has historically been an important source of economic growth. When the academic achievement of students completing their schooling declines substantially, the economic costs are large and last for generations. Consequently, the potential benefits of major improvements in academic achievement would also appear to be substantial.

Unfortunately, less than a quarter of tenth graders in the United States believe that geometry, trigonometry, biology, chemistry and physics are needed to qualify for their first-choice occupation. This perception is not in error. During the first years after leaving high school, the young men who go directly into the work force receive few rewards from the labour market for developing competence in science, language arts and mathematical reasoning. It would appear that the US needs to improve its signaling of academic competencies to employers if incentives to study mathematics and science during secondary school are ever to become as strong as they currently are in Europe and Japan.

(Adapted with permission from "Schooling, Learning and Worker Productivity." The complete text is available from the author, 607-255-2742 (tel) or jhb5@cornell.edu).