

# QUANTITATIVE LITERACY

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## **Introduction**

Quantitative literacy or numeracy refers to the arithmetic knowledge and skills that are required by individuals to function effectively at work and in society. This entry discusses the concept and measurement of quantitative literacy, the results of surveys examining the quantitative literacy skills of adults in various countries, and the links between quantitative literacy and social and economic outcomes.

Historically, the concept of literacy included only basic skills connected to reading and writing. Over the years, however, it has expanded to include other skills. In 1978, UNESCO adopted its definition of literacy, still used today, which incorporates quantitative literacy or numeracy, stating: “A person is functionally literate who can engage in all those activities in which literacy is required for effective functioning of his group and community and also for enabling him to continue to use reading, writing and *calculation* for his own and the community’s development.” Similar definitions have been adopted by the Organization for Economic Cooperation and Development (OECD) as well as international organizations and many national education agencies.

## **Measuring Quantitative Literacy**

Quantitative literacy is focused on essential skills that involve computations, arithmetic operations and mathematics concepts, either alone or sequentially, and that are required to function on a job or to carry out activities performed in daily living, such as figuring out a tip, calculating the overall cost of a list of products purchased, computing taxes owed from a tax table, etc. Although measurement of these skills can be determined by simply asking individuals

whether they know how to add, subtract, multiply and divide, the inaccuracy of self-identification and the more complex quantitative operations required by jobs and in the economy has led to the growing use of test-based measurement. Standardized tests of the quantitative skills of children in school are widely available through the efforts of national education agencies as well as international assessments of student achievement, such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study TIMSS). But data for adults (16 years of age or older) is more scarce.

The earliest studies adopting a comprehensive test-based measure of quantitative literacy were developed by Educational Testing Service and the United States Department of Education and included the 1985 Young Adult Literacy Assessment Survey, the 1990 Workplace Literacy Survey and the 1992 National Adult Literacy Survey. Currently, the OECD utilizes the same approach in its Programme for the International Assessment of Adult Competencies (PIAAC). The PIAAC has conducted quantitative literacy surveys for random samples of the population aged 16 to 65 in over 40 countries, with results published for 32 countries so far. Test scores are standardized across countries and range from 0 to 500, gathered into five levels of increasing proficiency, with scores at or below level 1 corresponding to a very rudimentary literacy, with the person able to carry out only operations with whole numbers, one at a time and in very concrete situations. Higher levels of proficiency progressively require two or more steps in calculations, more than one operation, use of decimals and –at the top level- the use of abstract thinking, the ability to use data to construct graphs and statistical representations, and utilizing more complex mathematical problem-solving strategies.

Of the sample of countries included as part of the PAAAC, Japan scores the highest –

with an average score of 288, followed by Finland (282), Belgium and the Netherlands (280), Sweden (279) and Denmark (280). The lowest scoring-countries include Chile (206), Indonesia (210) and Turkey (219). The United States has an average score of 253, below the OECD average of 263. In terms of the percentage of the population performing at or below the rudimentary skills level 1, among the countries tested those with the lowest percentages were Japan (8.1%), Finland (12.9%) and the Czech Republic (12.9%) while those with the highest proportion were Chile (53.4%), Turkey (50.2%), Italy (31.7%) and Spain (30.8%). The average for the United States was 27%. These figures suggest that even among high-income countries a substantial proportion of the population does not appear to have more than the rudimentary quantitative literacy skills.

### **The Effects of Quantitative Literacy Skills**

In a world of advancing use of digital technology and information in the workplace and at all levels of society it is not surprising that quantitative skills are rapidly becoming a significant determinant of success in the labor market. Indeed, as economists David Autor, David Card, Alan Krueger and Richard Murnane, among others, have documented, the forces of demand and supply have operated during the last 10 years to sustain an upward trend in the employment and salaries of jobs that require more technical skills, of which quantitative literacy is at the top. As the demand for high school and college graduates with minimum levels of mathematics proficiency has steadily increased, those without such skills are being displaced from the labor market, especially young workers.

In the United States, for example, a mismatch has emerged between the numeracy skills

demanded by employers and the supply of those skills by many workers entering the labor market. An early study by Francisco Rivera-Batiz at Columbia University showed that, holding other things constant, such as reading proficiency, higher quantitative literacy scores are positively and significantly associated with the likelihood of employment of young adult men and women in the labor market. More recently, results from the PIAAC surveys show that among unemployed high school dropouts in the United States, 59% performed at level 1 or lower in the quantitative literacy scale, and even among those who had a college credential, 46 percent of the unemployed performed at level 1 or below. Economists Ross Finnie and Ronald Meng have found similar results for Canada. More generally, for all countries in the PIAAC survey, persons scoring at a level 4 or 5—compared to level 1—in the quantitative literacy scale are 2.2 times more likely to be employed.

Higher quantitative literacy skills are also associated with higher wages. Using data compiled from the latest round of the PIAAC surveys, Stanford University's Erik Hanushek and his co-authors find that, controlling for other individual characteristics that might influence earnings, an increase of one standard deviation in quantitative literacy test scores is associated with an 18% increase in wages among prime-age workers, with the impact among U.S. workers equal to 28%. Similar results are obtained by Marguerita Lane and Gavan Conlon in their 2016 research. Other studies focusing on individual countries—such as Australia, Canada, Finland and the United Kingdom—or even among sub-groups of the population—like immigrants or racial and ethnic minorities—have produced the same results.

The impact of quantitative literacy is not restricted to the labor market. Financial decisions, for example, require the capacity to understand quantitative concepts or carry out mathematical operations that go beyond the rudimentary knowledge many persons have. The

research by economists Douglas Bernheim,, Annamaria Lusardi and others find that failure to have the necessary numeracy skills can lead to a variety of effects, ranging from frequent misunderstandings regarding credit and borrowing, which can generate serious personal indebtedness, to the lack of adequate retirement financial planning, which can seriously affect the standard of living of the elderly.

### **Policy Directions**

The rising importance of quantitative literacy in the labor market, in the financial sector and everywhere in the economy and society has led to an increasing emphasis in developing those skills in schools and in adult education. Countries with high quantitative literacy rates, like Denmark, Finland and the Netherlands, also have high rates of participation in adult education programs. Financial literacy programs, such as those fostered by the Federal Reserve in the United States, have also been essential in developing the applied numeracy skills required by the complex financial transactions often confronted by consumers.

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*See also* PISA, TIMSS, literacy,

## **FURTHER READINGS**

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