Towards the knowledge society: Fostering and measuring skills[1]

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Source: buriramtimes.com/thailands-students-scores-recent-test-results-caused-disparity

The growth of technological and scientific knowledge in the last two centuries has been the overriding driver of the world as we know it today; knowledge has been the foundation of economic prosperity.[2]

For example, Jane Gilbert, Chief Researcher at the New Zealand Council for Educational Research 2003-13, argued that "we are supposed to be striving to become a knowledge-based society" (Gilbert, 2005, p. 3). Eric A. Hanushek and Ludger Woessmann also make a strong argument in their book, *The Knowledge Capital of Nations*, that knowledge capital accounts for much of the income differences across countries (Hanushek and Woessmann, 2015). Knowledge matters!

HUMAN CAPITAL

The importance of human capital was recognised as far back as the 1600s when Sir William Petty discussed a relationship between the costs of war and the skill level of workers (see Hanushek, 2015). Before then, workers' abilities were not considered to be particularly relevant. Adam Smith wrote in *The Wealth of Nations* ([1776] 2003, p. 358) that just as important as 'fixed capital' are:

> The acquired and useful abilities of all inhabitants or members of the society. The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real experience, which is a capital fixed and realised, as it were, in his person. Those talents, as they make a part of his fortune, so do they likewise of that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays that expense with a profit.

In the second half of the twentieth century, interest in the value of acquired abilities was revived by considering how productivity is raised through investments in education, skills and knowledge. Scholars such as Gary S. Becker, Theodore W. Schultz, and Jacob Mincer pioneered the human capital approach in the late 1950s and early 1960s.[3]

Becker was influential in including human capital formulations into theoretical and empirical work, transforming the perspective of economics by making humans the central focus. Since his seminal 1964 book, *Human Capital*, human capital theory has been used to understand many facets of economic development. Becker emphasised the importance of human capital investment by relating earnings inequality to differences in talents, family backgrounds and other assets, motivated by the attempt to calculate private and social returns from investment in education.[4]

QUALITY VERSUS QUANTITY

Most literature on economic development uses average years of schooling data as a proxy for human capital.[5] But this quantitative perspective of human capital relies on two strong – and controversial – assumptions.

The first assumption is that a year of schooling is equally effective at raising someone's productivity regardless of where in the world the year of schooling is obtained. The second assumption is that other factors such as individuals' abilities, health and so on have negligible effects on human capital.

These two assumptions imply, among other things, that workers with the same educational achievement (in terms of years of schooling) embody similar amounts of cognitive skills. This is troublesome. According to Hanushek and Woessmann (2008, p. 608):

1. Parts of this article are based on the first author's Masters thesis (Campbell, 2018), which was supervised by the second author.
2. In *The Gifts of Athena*, celebrated economic historian Joel Mokyr argues that knowledge is the key to understanding many of the most important developments in the last two centuries (Mokyr, 2002).
3. In 1962, for example, the *Journal of Political Economy* published a special issue on human capital with several landmark papers.
4. nobelprize.org/nobel_prizes/economic-sciences/laureates/1992/becker-lecture.html
5. Previous research in empirical growth literature has used school enrolment rates to proxy for investment in educational human capital (e.g. Mankiw et al., 1992), whereas data on average years of schooling have been widely used to proxy for stocks of educational human capital.

> Most people would, in casual conversation, acknowledge that a year of schooling in a school in a Brazilian Amazon village was not the same as a year of schooling in a school in Belgium. They would also agree that families, peers, and others contribute to education. Yet, the vast majority of research on the economic impact of schools – largely due to expedience – ignores both of these issues. The data suggest that the casual conversation based on disparities in school attainment may actually understate the magnitude of differences in true education and skills across countries.

The Economist magazine looks at the case of India and discusses the fact that although more Indians than ever are attending school, learning is not improving. According to Yamini Ayar of the Centre for Policy Research (a think-tank in Delhi), "we have failed miserably in translating school into learning" (*The Economist* 2017, p. 21). McKinsey (2010, p. 20) reached a similar diagnosis for Africa:

> There is mounting evidence from surveys in Africa and in other developing countries that basic skills in reading and mathematics remain low. In some African countries, student test scores have stagnated or even declined ... In a South African survey, just 37% of respondents correctly answered more than half of 'real-life' math questions (e.g. A shop has 126 litres of milk. 87 litres are sold. How many litres remain?).

Recent evidence identifies the shortcomings of measuring human capital by only considering schooling attainment, and highlights the importance of the knowledge that is actually acquired. Many international tests are available for measuring the quality of education, but relying on such tests begs the following important questions.

How do international test scores shape education policy-making? Do they effectively represent and measure what we want for all our young people? Can competencies assessed by tests be considered the fundamental school knowledge that children and teenagers should possess?

We consider these three international tests in turn below: the Programme for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS).

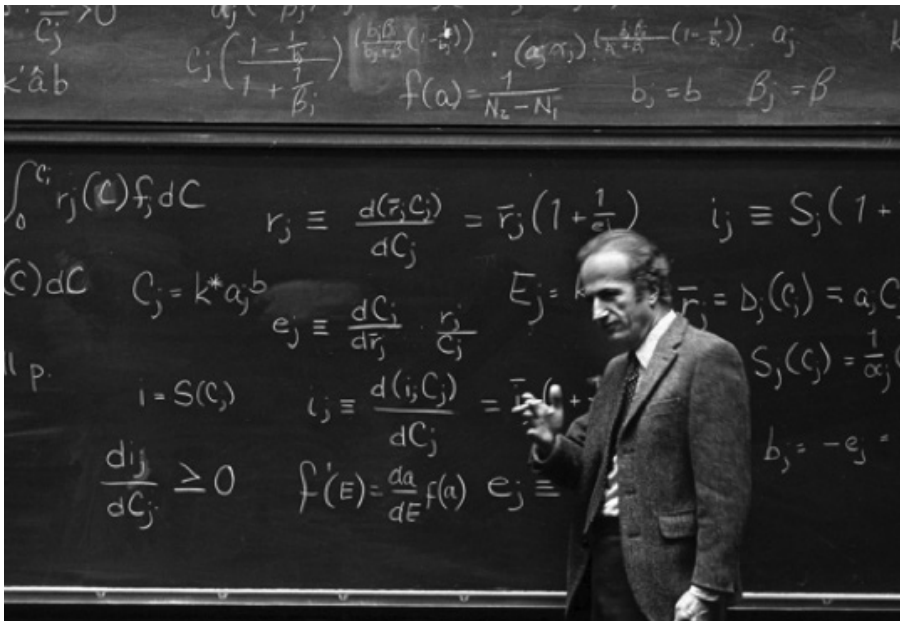
PISA

Launched by the OECD in 1997, the Programme for International Student Assessment (PISA) represents an attempt to monitor the outcomes of education systems worldwide in terms of student achievement, providing comparable data across countries on how to improve educational policies and outcomes.

Administered on a three-year cycle, PISA evaluates 15 year olds in three key learning areas: science, mathematics and reading. Approximately 540,000 students completed the assessment in 2015, representing around 29 million 15 year-olds in the schools of the 72 participating countries and economies.[6]

Table 1 reports the means and standard deviations of PISA test scores for the 32 countries that participated in all rounds of testing between 2000 and 2015.[7,8] The highest mean score in mathematics belongs to Korea (543.4), whereas the lowest mean is for Brazil (368.5). For the science test, Finland has the highest value (546.6), whereas the lowest is Indonesia (391.6); the same pattern is evident for the reading score: Finland has the highest score (537.2) and Indonesia the lowest (390).

Gary Becker taught at the University of Chicago for more than 30 years.



Source: news.uchicago.edu/article/2014/05/04/gary-s-becker-nobel-winning-scholar-economics-and-sociology-1930-2014

6. oecd.org/pisa/pisa-2015-results-in-focus.pdf
7. There is one exception: the US participated in every round, but their scores for the reading test in 2006 are not available. There was an error with the printing of the exam booklets, which was deemed to have invalidated the data, but the estimated effect of the error on the mathematics and science scores were agreed to be negligible. oecd.org/pisa/data/42025182.pdf
8. Xiang and Yeaple (2017) present a similar table tabulating over-time changes of PISA scores.

Table 1. Within-country, over-time variations of PISA scores, 2000-2015

COUNTRY	MEAN SCORES			STANDARD DEVIATION		
	Mathematics	Science	Reading	Mathematics	Science	Reading
Australia	515.0	523.0	516.0	14.2	6.8	9.4
Austria	502.0	500.3	486.3	4.5	7.9	8.2
Belgium	517.7	504.7	504.7	7.4	5.3	4.0
Brazil	368.5	393.8	402.9	20.6	11.1	7.2
Canada	525.5	527.4	527.2	7.2	5.2	3.9
Czech Republic	501.3	508.2	486.9	9.7	10.5	5.5
Denmark	509.4	492.0	495.8	6.2	11.1	2.5
Finland	533.2	546.6	537.2	14.9	11.6	10.1
France	501.4	499.9	498.2	10.1	6.0	6.6
Germany	504.8	509.8	497.4	8.6	13.6	9.6
Greece	454.0	467.8	472.1	7.8	9.3	8.0
Hungary	485.5	496.2	482.7	6.7	10.3	8.3
Iceland	503.8	488.1	491.2	11.2	9.9	10.4
Indonesia	375.1	391.6	390.0	11.7	8.1	11.7
Ireland	499.9	509.9	516.5	6.3	6.9	11.0
Italy	473.8	483.7	482.0	13.8	7.0	8.2
Japan	535.3	542.3	515.4	11.4	7.2	15.4
Korea	543.4	534.0	534.6	10.2	13.0	13.2
Latvia	481.2	487.5	481.4	9.6	14.3	12.1
Luxembourg	482.3	478.4	473.6	18.1	17.6	16.6
Mexico	403.0	413.8	417.4	13.7	5.8	10.2
New Zealand	516.1	523.3	519.0	15.7	7.9	7.1
Norway	495.6	494.0	501.6	5.1	7.0	9.6
Poland	495.4	502.3	501.3	15.7	14.1	13.1
Portugal	475.2	480.7	482.5	15.3	16.2	10.9
Russia	477.7	480.0	462.2	9.8	10.6	20.6
Spain	482.5	490.7	483.1	3.7	3.5	12.5
Sweden	497.9	499.2	503.1	11.8	9.9	12.2
Switzerland	528.6	509.6	499.1	4.3	7.8	5.8
Thailand	421.2	429.5	423.2	6.8	9.1	11.3
United Kingdom	502.0	517.0	502.8	14.6	7.9	11.1
United States	481.5	495.9	498.8	8.5	5.0	3.6

Source: OECD PISA, oecd.org/pisa/data

With respect to Finland's highly successful education system, according to the World Bank's Cristian Aedo:[9]

> Finland is an example of a country that has not followed many of the global education reform principles. There is no standardised tests or school inspections but the education system leans on "intelligent" accountability. This means that while there are national quality standards for learning and teaching in the form of national core curriculum and laws and regulations, there are no rankings of the schools based on test results. However, self-evaluation of schools and education providers exists and are regularly applied.

Finland: An educational miracle?

Source: blogs.worldbank.org/education/miga/category/tags/pisa (Photo: World Bank)

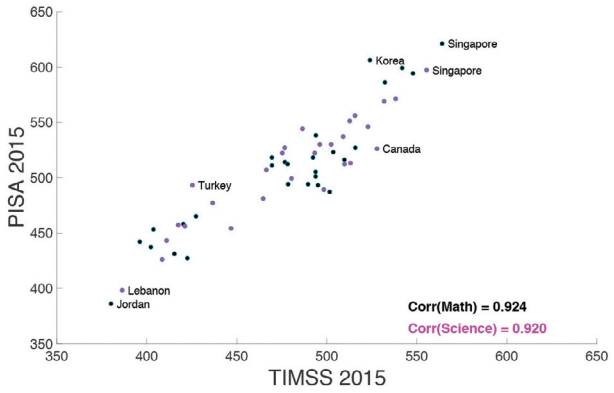
9. blogs.worldbank.org/education/miga/finland-miracle-education

TIMSS

Developed by the IEA (International Association for the Evaluation of Educational Achievement) in 1995, Trends in International Mathematics and Science Study (TIMSS) began its first four-year cycle assessing student performance in mathematics and science and describing the environment in which students acquired these skills.

Both PISA and TIMSS cover similar material and test 8th-graders (13-14 year olds). Figure 1 plots the scores obtained by participating countries in the mathematics and science examination of these two tests in 2015, where 28 countries participated in both rounds of testing.[10] Scores are highly correlated: for the mathematics test, the correlation is of 0.924, and for science, 0.920.

Figure 1. Performance in mathematics and science: TIMSS vs. PISA, 2015



PIRLS

Also developed by the IEA, Progress in International Reading Literacy Study (PIRLS) tests student achievement in reading every 5 years. The first study was conducted in 35 countries in 2001, and was designed to measure trends in achievement of primary school students in each cycle, as well as collect background information.[11]

WHAT ABOUT NONCOGNITIVE SKILLS?

A weakness of international test scores is that they neglect noncognitive human capital, such as conscientiousness, conformity, motivation, perseverance, tenacity and trustworthiness, which are like to be important too. For reasons of data availability, the focus of skills measurement is usually just on cognitive skills, whereas noncognitive skills are not adequately captured by IQ tests and achievement tests.

According to Heckman[12] and Rubinstein (2001, p. 145), "no single factor has yet emerged to date in the literature on noncognitive skills, and it is unlikely that one will ever be found, given the diversity of traits subsumed under the category of noncognitive skills." Similarly, Hanushek and Woessmann (2011, p. 95) write that "the systematic measurement of such skills has yet to be possible in international comparisons." Kautz et al. (2014) provide a comprehensive discussion of recent attempts by psychologists and economists to develop reliable measures of noncognitive skills. We look forward to considering the progress of related research in the upcoming years.

QUESTIONS TO THINK ABOUT

1. How do 15 year-olds from NZ compare with those from other countries in math and science?
2. If you were a parent, would you want your child to attend a school with a higher or lower number of students per teacher?
3. Are international test scores good indicators of labour force quality?
4. Do better schools lead to more growth?

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10. These countries are: Australia, Canada, Chile, Chinese Taipei, England, Georgia, Hong Kong, Hungary, Ireland, Israel, Italy, Japan, Jordan, Korea, Lebanon, Lithuania, Malta, New Zealand, Norway, Qatar, Russia, Singapore, Slovenia, Sweden, Thailand, Turkey, the United Arab Emirates and the US. PISA reports data for the UK, whereas TIMSS reports only for England. With respect to TIMSS, values for Kuwait do not include private schools, and those for Lithuania do not include students taught in Polish or Russian.
11. Concerns have been raised that the tests may be more difficult for students in the developing countries of Latin America and Africa, and thus may not provide reliable information when comparing the variation in countries' performance (Hanushek and Woessmann, 2012). For this reason, Campbell (2018) also considers regional testing in Latin America, which provides an alternative measure of schooling achievements.
12. In 2000, James Joseph Heckman shared the Nobel Prize in Economics for his work on the microeconometrics of diversity and heterogeneity and for establishing a sound causal basis for public policy evaluation.