Commentary

PISA Problems

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Abstract

Pundits and bureaucrats use the results from international tests, particularly the PISA, to make claims about the quality of the public education system in the United States and make policy recommendations. In this article I argue, with evidence, that the scores and rankings from PISA are not important and that they cannot give policy makers or educators meaningful insights into student preparedness for the global economy.

Key Words

PISA, international testing, international comparisons

Introduction

The U.S. Secretary of Education, Arne Duncan, warned that the U.S. public education system was in a state of stagnation following the December 3, 2013, release of the 2012 Programme for International Student Assessment (PISA) results. Duncan (2013) proclaimed:

> The PISA is an important, comparative snapshot of U.S. performance because the assessment is taken by 15-year-olds in high schools around the globe. The big picture of U.S. performance on the 2012 PISA is straightforward and stark: It is a picture of educational stagnation. That brutal truth, that urgent reality, must serve as a wake-up call against educational complacency and low expectations.

How important are PISA results? I dispensed with the fraudulent claims by bureaucrats and pundits of educational stagnation in previous articles and books (Tienken, 2011; 2013a; 2013b; Tienken & Orlich, 2013).

Hence, I do not allocate many words for the topic here. In this article I argue that the scores and rankings from PISA are not important and that they cannot give policy makers or educators meaningful insights into student preparedness for the global economy.

Importance of PISA

Why would the results from one test, even a so-called international test of academic achievement, be important to the largest economy on the planet and third most populous nation? According to bureaucrats like Arne Duncan (2013) and some education pundits (Hanuschek & Woessman, 2008), the rankings from PISA equate to or even predict national economic fortunes. It seems to some, that the economic fate of nations hangs on PISA rankings. As Duncan (2013) exclaimed:

> In a knowledge-based, global economy, where education is more important than ever before, both to individual success and collective prosperity, our students are basically losing ground. We're running in place, as other high-performing countries start to lap us.

Duncan insinuates that the rankings from the PISA test provide important information about the quality of a country's education system related to preparedness for the knowledge-based, global economy.

In essence, according to the bureaucrats and pundits that use PISA results to make or suggest education policies, the PISA test rankings and scores (1) are a proxy for the overall education quality of a country, (2) quantify how prepared 15-year-olds are to compete in the global economy, and (3) predict future economic prosperity at the country level. But what does PISA say about PISA in terms of what the rankings and scores can and cannot tell about a nation's education system or future economic success?

What PISA Says Regarding Its Ability to Judge Quality

I wrote previously about some comments by PISA researchers (see Tienken, 2013c) regarding the appropriate use of the results as a proxy for education quality, and I use and expand upon that work in this article.

The Organisation for Economic Co-operation and Development (OECD, 2013, p. 265), the private entity that develops and vends the PISA, explains that policy makers should not use results either to indict or commend education systems. Furthermore, they should

not use the results to make important policy decisions. In fact, the OECD authors explain that PISA results are due to a combination of variables, including but not limited to schooling, life experiences/home environment, poverty, access to early childhood programs, and health.

> If a country's scale scores in reading, scientific or mathematical literacy are significantly higher than those in another country, it cannot automatically be inferred that the schools or particular parts of the education system in the first country are more effective than those in the second. However, one can legitimately conclude that the cumulative impact of learning experiences in the first country, starting in early childhood and up to the age of 15, and embracing experiences both in school, home and beyond, have resulted in higher outcomes in the literacy domains that PISA measures (p. 265).

Additionally, the OECD authors (2013) reported that parents' education level accounted for 23% of the 2012 mathematics score (p. 34).

Poverty

Although bureaucrats and pundits like to dismiss poverty as just another excuse by educators for poor performance, the information in the PISA technical manuals suggests otherwise. Poverty explains up to 46% of the PISA mathematics score in OECD countries (OECD, 2013, pp. 35-36), the United States being one of those countries.

The strong relationship between poverty and test results does not help the United States shine on the PISA. Remember that the United States has one of the highest childhood poverty rates of the major industrialized countries (OECD, 2009, p. 26). Approximately 22% of our public school children lived in poverty in 2012 compared to 15.6% in 2000 (Snyder, 2011, Table 27). In 2010, almost 48% of public school children qualified for either free or reduced lunch (Snyder, 2011, Table 45).

The United States ranks 26th out of 29 industrial countries in overall well-being of children, just ahead of Lithuania, Latvia, and Romania, but behind countries like Estonia, Hungary, and Slovakia (UNICEF, 2013, p. 2).

We can gain a glimpse of what the U.S. mathematics scale score and rank might be if we had only 15% child poverty compared to the 23% nationally. Massachusetts (MA) bureaucrats spent taxpayer money administering PISA to a representative population of their students.

Just as Tirozzi (as cited in Riddle, 2010) demonstrated with the results from the PISA 2009 tests, the U.S. rankings and scores change when the data are disaggregated by poverty rates. Students in schools with less than 10% of the students in poverty ranked and scored at the top of the world.

As I did with the TIMSS scores in 2012, I used the 2012 PISA math score and ranking from Massachusetts to model what the scores of students from a less poor America might look like on the PISA tables. Although 15% poverty is higher than almost all the countries that outranked the United States, it does provide a concrete example of the influence of poverty on PISA results and provides insight as to how the U.S. students might score if fewer of them lived in poverty.

Students in Massachusetts scored 520 on the mathematics portion. That score moves the United States from 29th to 12th, one point behind Estonia. If one disregards the non-representational cities that take PISA (Hong Kong, Macao, Shanghai) because their testing populations do not represent the country of

China, the United States moves into 9th place, hardly a crisis situation. The other countries that outrank the United States, including Switzerland, Lichtenstein, Netherlands, Japan, Korea, and Singapore, all have lower levels of child poverty than 15%.

Mathematical PISA Connection to Poverty

Poverty not only explains a large percentage of the PISA results, it also relates to important student attributes that further influence achievement.

Poverty relates to mathematical self-efficacy on the PISA, and self-efficacy relates strongly to mathematics achievement with a correlation of .5 (OECD, 2013b, p. 83) On average, 28% of the variance in PISA mathematics results can be explained by self-efficacy. In the United States the difference between students with high self-efficacy in math and those with low self-efficacy is approximately 50 scale score points (OECD, 2013b, p. 86). Poverty also relates to math anxiety.

Poorer students have more anxiety about math. Like self-efficacy, anxiety relates to achievement and accounted for an average of 14% of the variance in math scores (OECD, 2013b, p. 87).

Selection Bias

Some might question why I do not include the Chinese cities that are part of PISA in my analyses. I remove Hong Kong and Macao from international testing samples because their testing samples do not represent the country of China. They are special administrative regions of the People's Republic of China, and their schools do not follow all of the standardization requirements of the Chinese system (Levin, 2012).

I remove Shanghai because it is a city of almost 23 million people and home to almost 140,000 millionaires, making it the city with the third highest concentration of wealth in China. The population is highly educated and international. Approximately 83.8% of the high school seniors in Shanghai continued on to attend college in 2008 according to the Shanghai.gov (2013) official website.

Compare that to less than 25% of all high school graduates nationally in China (Loveless, 2013). The wealth and family demographics of Shanghai simply do not approximate those of the country of China, where 29% of the population, more than 392 million people, live on $2 a day or less (World Bank, 2012). That is more people than the entire population of the United States.

High school is not free in China. Only the students whose parents can afford to pay are in school at age 15. That limits the testing pool severely, even in Shanghai. Also, not all children who live in Shanghai are allowed to attend high school there, especially if those children are poor.

Some of the poorer children are required to attend high school in their ancestral provinces and not permitted in the Shanghai schools (Loveless, 2013). Do not expect to see many students with special needs in Shanghai or Chinese high schools in general. Many are not in school by age 15 (Ringmar, 2013).

Education prospects are even worse in the rural areas, and the statistics provide more evidence as to why the results from Shanghai should not be considered in analyses. According to the Rural Education Action Program (REAP, 2013a), only approximately 40% of rural children attend high school in China (REAP, 2013b) and between only 35-45% of students graduate from high school in China, not to mention that 25% of middle school students drop out before entering grade nine (REAP, 2013a). When "China" starts

taking the PISA, then I will include "China" in the testing samples for calculating ranks.

Right now, we basically have the general-education Beverly Hills version of China, masquerading as the nation of China, taking the PISA test.

Top of the Pack Teachers

Pundits and bureaucrats often make their rebuttals that it is teacher quality, not poverty or selection bias, nor a multitude of other issues with PISA, for the reason the United States ranks and scores so dreadfully low on PISA math. Well, the PISA authors have some data for that.

The PISA assessments include various surveys of students, teachers, and school principals. One such survey reports on teachers' use of cognitive activation strategies when teaching math. Only four countries, Bulgaria, Jordan, Qatar, and the United Arab Emirates (UAE), score higher on the use of those effective teaching strategies (OECD, 2013b, p. 117).

Another survey tracks the use of other effective teaching strategies. The United States ranks above the OECD average and near the very top of the following indicators: (a) The teacher sets clear goals for our learning; (b)

The teacher asks me or my classmates to present our thinking or reasoning at some length; (c) The teacher asks questions to check whether we have understood what was taught; (d) At the beginning of a lesson, the teacher presents a short summary of the previous lesson; and (e) The teacher tells us what we have to learn.

Only teachers in the countries of Chile, Mexico, Turkey, Albania, Bulgaria, Columbia, Indonesia, Jordan, Kazakhstan, Qatar, Russia, Shanghai, Thailand, and UAE rank higher on some, but not all of those, indicators than teachers in the United States (OECD, 2013b, p. 118).

For bureaucrats and pundits to claim that the U.S. ranking and score on the mathematics portion of the PISA is due to poor quality teaching, in the face of the evidence presented by PISA to the contrary, is feckless.

Proxy for Quality?

Are the PISA results in mathematics an appropriate proxy for the quality of an education system? I do not think so. Many factors influence PISA scores and rankings.

Based on the information presented by the OECD/PISA, poverty influences mathematics achievement directly, and indirectly through self-efficacy and anxiety.

The United States has one of the highest percentages of child poverty and one of the lowest levels of overall child well-being in the industrialized world. The technical details of the PISA results suggest (1) that it is the social fabric of a country that exerts a large amount of influence over the education system and achievement, and (2) achievement in the United States will improve greatly if poverty rates for children decrease.

The data suggest that factors outside the control of school personnel affect PISA scores in important ways. The results appear to provide a look into the overall society of a country on a very macro level rather than an accurate description of its education system.

Furthermore, the OECD researchers warn readers to remember that formal schooling does not end in most countries when a child turns 15 or 16, the ages of the PISA student testing pool. In most industrialized countries, the majority of students continue their formal public school education for another

two or three years; and they are exposed to more content in mathematics, science, and reading during those remaining years.

The OECD researchers explain that the results from a test of 15-year-old children could not account for all their academic abilities. According to the authors of the PISA 2009 technical manual (OECD, 2009 p. 261), student age and curriculum alignment contribute to some of the differences in the scores and rankings among countries.

> This is not only because different students were assessed but also because the content of the PISA assessment was not expressly designed to match what students had learned in the preceding school year but more broadly to assess the cumulative outcome of learning in school up to age 15. For example, if the curriculum of the grades in which 15-year-olds are enrolled mainly includes material other than that assessed by PISA (which, in turn, may have been included in earlier school years) then the observed performance difference will underestimate student progress.

The authors of the PISA technical manual state their cautions about curriculum alignment and the influence on results (2009, p. 48):

> PISA measures knowledge and skills for life and so it does not have a strong curricular focus. This limits the extent to which the study is able to explore relationships between differences in achievement and differences in the implemented curricula.

But what "skills for life" does PISA measure? A look at the released items suggests that some of the content measured is just rehashed versions of subject matter that has been around for the last 120 years: Hardly 21st century skills (Dancis, 2014; Sjoberg, 2012; Stewart, 2013). The PISA ranking or scale score does not provide insights into authentic resilience, persistence, collaboration, cooperation, cultural awareness, strategizing, empathy, compassion, or divergent thinking.

So, if the vendors of PISA repeatedly warn that (a) PISA is not aligned to school curricula, (b) the scores and ranks are influenced strongly by poverty and selection bias, (c) the skills are left over from the 19th and early 20th centuries, and (d) one test of a 15- year-old child cannot possibly represent the future success of that child or of a country, then what does PISA really tell us about the quality of a school system? Not much.

Prepared for Global Competitiveness?

What is global competitiveness? What jobs are U.S. children competing for and where are those jobs? How well does a PISA rank or score explain how a nation's students are prepared to "compete in the global economy" of the 21st century?

The OECD authors attempt to define global competitiveness (2013b).

> In this globalised world, people compete for jobs not just locally but internationally. With the integration of labour markets, workers in wealthier countries are competing directly with people with much the same skills in lower-wage countries. The competition among countries now revolves around the quality of their human capital and their ability to create the institutional structures and opportunities to effectively use the skills and talents of their populations. (p. 26)

The authors seem to speak with forked tongue on the issue. The first sentence suggests that the global economy includes competition

for jobs from international actors. For example, a bureaucrat in the United States might claim that the "Chinese" will take our jobs. Yet the third sentence suggests that global competition hinges more on country-level industrial policies and that countries should develop structures and opportunities for the skills of the people in their national populations. Finally, the second sentence indicates that the global economic competition is more about wages and costs.

But then, the OECD authors disregard their wages and costs argument and return to education as the sole solution to competitiveness:

> The result of technological progress has been a reduction in the demand for people who are only capable of doing routine work, and an increase in the demand for people who are capable of doing knowledge-based work or manual work that cannot be automated. This leads to a greater polarisation of labour market opportunities, both within and across countries, with a greater proportion of people who will need to be educated as professionals. (p. 26)

Within the span of two paragraphs, the authors move from competitiveness that is global in nature with students across countries competing for a seemingly limited number of jobs, based on wage pressures, to competition within countries in which markets should be created in part with help from government policy, and finally to a dichotomous market situation of knowledge-based work and manual labor. Perhaps it is a combination of those situations that makes up a more informed understanding of globalization.

International Competitors

The frequently peddled fear that students from China, India, or another country are going to come to the United States and take jobs away from U.S. students on a large scale does not hold empirical water. A foreign national must be issued a visa to claim employment in the United States, especially for high tech jobs and white collar employment.

There are limited numbers of visas issued because the quota is controlled by legislation enacted by the U.S. Congress, not based on a PISA rank. The knowledge-based jobs mentioned by PISA most commonly require H-1B or O visas.

In 2001, the annual quota for new H-1B visas was set by Congress at 115,000 (Ruiz et al., 2012). The total number of H-1B visas approved that year was 161,643. By 2011, the number dropped to approximately 130,000 with 11 out of the top 18 companies requesting H-1B visas being foreign owned doing business in the United States.

Those foreign-owned multinational corporations were importing labor from their home countries (Ruiz, et al., 2012; Thibodeau, 2009). Multinational corporations are not the only large-scale importers of foreign labor. The New York City public schools received 642 approvals in 2006 for visas, almost twice the number received by Google (McGee, 2007).

The takeaway is that the number of H-1B visas granted to highly skilled foreign workers is miniscule compared to the overall size of the labor force.

The fear that highly skilled foreign-born workers will "take" jobs from U.S. workers is overstated. The largest employment sectors for highly skilled workers include the U.S. government and the defense and aerospace industries.

The government and high tech industries have strict rules severely limiting the

employment of foreign-born workers in sensitive high-skill positions.

Couple that with the fact that the Congress could end completely the practice of allowing approximately 300,000 foreign born workers currently in the market from accessing the high skill U.S. job market, and the argument that there is large-scale competition between students across the globe does not match the evidence.

International Job Market

If global competition for high skill jobs from international actors in the United States does not exist on a large scale, then bureaucrats are not justified in attaching fear of international global competition for jobs to PISA rankings and scores.

But what about competition for jobs abroad? That competition is largely driven by employment in multinational corporations and entrepreneurial activities.

Large multinational corporations employ over 23 million Americans and account for over 19% of total employment, with 68% of the multinational workforce of U.S. parent companies coming from the United States (U.S. Department of Commerce, 2012).

An additional 5 million Americans were employed by majority-owned U.S. affiliates of foreign multinational corporations doing business in the United States (U.S. Department of Commerce, 2012). The majority of U.S. multinational corporate employees are American.

PISA Is Unprepared

Unfortunately for those who knowingly, or unknowingly, peddle PISA results to drive education policy, there are no relationships among PISA rankings or scores and being prepared for employment in multinational corporations or entrepreneurial activities.

Consider that approximately 10% of Chinese engineers and Information Technology (IT) workers are prepared to work in multinational corporations (Kiwana et al., 2012). Similarly, only 25% of Indian engineers and IT workers are employable in those types of corporations (Gereffi et al., 2006; Kiwana et al., 2012). Compare that to approximately 81% of U.S. engineers and IT professionals (Kiwana et al., 2012) who are qualified for employment in multinational corporations.

The results from the *2012 Global Chief Executive Officer Study* conducted by the IBM Corporation made several recommendations for the skills necessary in the global economy.

The recommendations run counter to the skills assessed on the PISA examination and call into question the use of PISA results as an indicator of being prepared for the global economy.

According to 1,700 CEO‘s representing 64 countries and 18 major industries, leaders and employees in the global economy must be able to:

(a) innovate
(b) collaborate and cooperate globally amongst themselves and with their customer bases;
(c) be creative;
(d) seek opportunity
(e) use complexity to a strategic advantage; and
(f) be communicative (pp. 21-24).

PISA tests 19th and 20th century skills, decontextualized, and based on imitation, regurgitation, and application of pre-existing and predetermined ideas and facts (Dancis, 2014, Sjoberg, 2012).

Furthermore, the most prevalent language used in multinational corporations is English. PISA does not test English language skills of non-English speaking students.

Entrepreneurial Drive

The United States was second only to Indonesia in the G20 group of countries in terms of the percentage of its population aged 25 years and older categorized as nascent entrepreneurs since 2006: 8.9% versus 9.6%. China had less than 6% of its population categorized as entrepreneurs (Global Entrepreneurship Monitor, 2013).

1As I published previously (Tienken, 2013a), the authors of the Global Entrepreneurship and Development Index (Acs & Szerb, 2010), ranked the United States third on the overall Global Entrepreneurship Index, behind Denmark and Canada but ahead of countries like Japan, China, Singapore, and Finland. The United States ranked sixth on the index of Entrepreneurial Attitudes, ahead of Finland, Norway, Germany, Japan, and Singapore. China ranked in the lower third of the world. The United States ranked first on the Entrepreneurial Aspirations Index and sixth on turning those aspirations into reality, once again ahead of PISA powerhouses like Japan, Germany, Singapore, and Finland. China was near the bottom of the world rankings for aspirations and transforming aspirations into entrepreneurial actions.

A statistically significant relationship does not exist between PISA rankings and the percentage of a population that is entrepreneurial.

PISA rankings and scores do not equate to or relate to student readiness to compete in the global economy, neither at home nor on the international scene (Zhao, 2012). If they did, then students from Latvia, Estonia, Hungary, Slovenia, Vietnam, and Poland should be outcompeting students from the United States in the global marketplace based on their superior education. There is no evidence that is occurring.

The Real Competition

The real competition in the global economy is for wages and the transfer of high technology from multinational corporations that have it to countries that lack it.

The United States has one of the most highly educated and most productive workforces in the world (OECD, 2012) and one of the most highly paid. Because PISA measures skills more associated with those required for routine manufacturing or industrial jobs, the discussion of rankings and scores does not influence the real competition. Keep in mind the ranks and scores relate to the performance of 15-year-olds.

Learning and the development of economically competitive adults do not end at age 15. PISA ranks and scores do not relate to the percentage of adults with undergraduate degrees in a country or the percentage of PhD's.

Waging Competition

Wages play a role in competitiveness (Bureau of Labor Statistics, 2012). In many cases, for-profit multinational corporations, like GE or Boeing, are beholden to shareholders, not the greater good of the residents of the United States. Their goal is to maximize profits.

Therefore, it is more likely that they look to hire employees at the lowest wages the market will allow and set up factories in countries with the lowest overall costs of doing business (Prestowitz, 2012). The ideology of shopping for the lowest bidder was exemplified by the comments of former GE CEO Jack Welch during a 1998 interview with Lou Dobbs on CNN's Money Week. Welch said, "Ideally,

you'd have every plant you own on a barge to move with currencies and changes in the economy."

The concept of shopping for employees nullifies the claim that high PISA scores translate to higher levels of competitiveness. Competitiveness is a combination of labor stock, wage pressures, trade policy in terms of tariffs and protectionism, and fluctuations in currency rates, to name a few factors (Prestowitz, 2013).

In the G8 and G14 groups of countries, the education levels are already the highest in the world. The labor stocks exist. Businesses have gone, and continue to go, to less developed countries that have small pockets of well educated people and set up shop because those people will work for $2 - $25 dollars a day instead of $250. How is a PISA rank going to fix that problem?

In terms of the highest of the "high-tech" jobs, the United States is not losing competitiveness because of education policy. It is losing competitiveness because of industrial policy.

Companies like GE and Boeing recently signed multi-year agreements with the Chinese government that will allow them to sell Boeings and GE avionics equipment in China. However, the catch is that those companies must transfer the technology to the Chinese (Prestowitz, 2012).

Not only are large U.S. based corporations giving away the technology, they are also giving away some of the high technology jobs involved in designing, making, and installing the Boeings and avionics equipment. Project 20-30 years forward and will this mean that the United States is importing Boeings from China made mostly with American trained Chinese labor?

The United States already imports the tail stabilizers for some 737 aircraft from a Chinese manufacturer (Prestowitz, 2012).

Why? Because of the drive to maximize profits through low wages and overall costs, not due to a shortage of qualified workers in the United States.

But also because large, U.S. based multinational corporations want access to the Chinese market and they are making the taxpayers pay for that access by importing products from the Chinese that are already made or can be made easily in the United States.

The United States bureaucrats in the government could make the imported Chinese stabilizers less cost effective by attaching tariffs. They could restrict high technology from being transferred. But they do not. Ranks and scores on PISA will not fix those problems.

Do not be fooled. There is a strong, statistically significant relationship between our growing trade with China since 2001 and the loss of our high quality manufacturing jobs (Pierce & Schott, 2012; Traywick, 2013).

Technology transfers have also increased steadily since 2001. Is it surprising that wages and overall labor costs are reasons multinational corporations choose to sell out the American public and set up shops in places like Pakistan, Cambodia, India, China, Bangladesh, and Haiti?

Crystal Ball of Economics

Some, including the vendors of the PISA, have claimed that PISA points translate to increases in gross domestic product (Duncan, 2013, Hanushek & Woessman, 2008; OECD, 2010). Of course one test score or rank cannot possibly predict economic growth or sustainability, but the claims persist. U.S.

students have never scored at the top of the ranks on PISA or any other international test given since 1964.

Students from countries like Estonia, Slovenia, Slovak Republic, Poland, and Latvia outrank U.S. students on every PISA. What is their per-capita GDP? It is not even close to that of the United States (CIA World Fact Book, 2013). How many Nobel Prizes have they won? How many utility patents do they produce each year? Are they going to "out-compete" the United States? I don't think so.

The United States produces almost as many utility/innovation patents per year as the rest of the world combined (USPTO, 2012). U.S. scientists produce the largest number of scientific papers per year, and those papers are cited over 40 million times (Thompson Reuters, 2011).

The United States has outpaced the world in Nobel Prizes in the sciences and medicine since 2000 by a factor of almost 4 (Nobelprize.org, 2013). Ranks on PISA or any other international test do not relate well to economic strength in the G20 countries (Tienken, 2008) or overall global competitiveness.

The supposed cause and effect link between international test rankings and economics for the largest economies on the planet is a fallacy.

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